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ABBREVIATED TITLES USED IN THE ABSTRACTS

Abbreviated Title.	*Journal.*
Aircr. Engng	Aircraft Engineering.
Ann. Min. Belg.	Annales des Mines de Belgique.
Ann. Min. Roumanie	Annales des Mines de Roumanie.
Ann. Off. Combust. liq.	Annales de l'Office National des Combustibles Liquides.
Asph. u. Teer	Asphalt und Teer.
Auto. Engr	Automobile Engineer.
Auto. Tech. Z. (Berlin)	Automobiltechnische Zeitschrift (Berlin).
Azerb. neft. Khoz.	Azerbaidzhanskoe Neftyanoe Khozyaistvo.
Beitr. angew. Geophys.	Beitrage angewandte Geophysik.
Beitr. Geophys.	Beitrage zur Geophysik.
Bitumen	Bitumen.
Bohrtech. Z.	Bohrtechniker Zeitung.
Bol. Geol. y Min. (Caracas)	Boletin de Geologia y Mineria (Caracas).
Bol. Inform. Petroleras (B.A.)	Boletin de Informaciones Petroleras (Buenos Aires).
Boll. Soc. geol. ital.	Bolletin de la Societa Geologica Italiana.
BrennstChemie	Brennstoff Chemie.
Bull. Acad. Sci. (U.S.S.R. Inst. Seismol.)	Bulletin of the Academy of Sciences (U.S.S.R. Institute of Seismology).
Bull. Amer. Ass. Petrol. Geol.	Bulletin of the American Association of Petroleum Geologists.
Bull. Amer. geol. Soc.	Bulletin of the American Geological Society.
Bull. Ass. franç. Tech. Pétrol.	Bulletin de l'Association Français des Techniciens du Pétrole.
Bull. Inst. Min. (metall.) Engrs	Bulletin of the American Institute of Mining and Metallurgical Engineers.
Bull. Math. Phys. Éc. polyt. Bucharest	Bulletin de Mathematique et de Physique, Bucharest (École-polytechnique).
Bull. roum. geol. Soc.	Bulletin of the Roumanian Geological Society.
Bull. seismol. Soc. Amer.	Bulletin of the Seismological Society of America.
Bull. Univ. Texas (Bur. econ. Geol. Techn.)	Bulletin of the University of Texas (Bureau of Economic Geology and Technology).
Bur. Stand. J. Res., Wash.	United States Bureau of Standards Journal of Research, Washington.
Calif. Oil World	California Oil World.
Canad. J. Res.	Canadian Journal of Research.
Canad. Min. J.	Canadian Mining Journal.
Canad. Min. metall. Bull.	Bulletin of the Canadian Institute of Mining and Metallurgy.
Chem. & Ind.	Chemistry and Industry.
Chem. Rev.	Chemical Reviews.
Chem. Tr. J.	Chemical Trade Journal.
Chem. Wkbld	Chemische Weekblad.
Chim. e Industria	La Chimica e l'Industria.
Chim. et Ind.	Chimie et Industrie.
C.R. Acad. Sci. (Paris)	Comptes Rendus hebdomadaires des Seances de l'Academie des Sciences (Paris).
C.R. Geol. Pétr. (Strasbourg)	Compte-Rendu des Seances du Groupe des Geologues Pétroliers de Strasbourg.
11me Congrès Mond. Pétrole	11me Congrès Mondial du Pétrole (Paris, 1937).
Diesel Eng. Us. Ass.	Diesel Engine Users Association.
Direccion Minas y Geol.	Publication of Direccion Minas y Geologicas (Argentine).
Econ. Geol.	Economic Geology.
Engineer	Engineer.
Engineering	Engineering.
E.P.	English Patent.
Fuel	Fuel in Science and Practice.
Gas Oil Pwr	Gas and Oil Power.
Geol. Mag. (Lond.)	Geological Magazine (London).
Geophys.	Geophysics.

Abbreviated Title.	*Journal.*
Glückauf	Glückauf.
Groz. Neft.	Groznenskii Neftyanik.
Industr. Engng Chem.	Industrial and Engineering Chemistry.
Industr. Engng Chem. Anal.	Industrial and Engineering Chemistry, Analytical Edition.
Industr. Pwr & Fuel Econ.	Industrial Power and The Fuel Economist.
Instruments	Instruments.
Int. Z. Bohrtech.	International Zeitschrift für Bohrtechnik.
J. Amer. chem. Soc.	Journal of the American Chemical Society.
J. appl. Chem. (U.S.S.R.)	Journal of Applied Chemistry, U.S.S.R.
J. appl. Phys.	Journal of Applied Physics.
J. chem., metall. min. Soc. S. Africa	Journal of the Chemical, Metallurgical and Mining Society of South Africa.
J. chem. Soc.	Journal of the Chemical Society.
J. Fuel Soc. Japan	Journal of the Fuel Society of Japan.
J. Geol.	Journal of Geology.
J. Inst. Fuel	Journal of the Institute of Fuel.
J. Instn auto. Engrs	Journal of the Institution of Automobile Engineers.
J. Inst. Petrol.	Journal of the Institution of Petroleum Technologists.
J. org. Chem.	Journal of Organic Chemistry.
J. phys. Chem.	Journal of Physical Chemistry.
J. R. aero. Soc.	Journal of the Royal Aeronautical Society.
J. Soc. aut. Engrs	Journal of the Society of Automotive Engineers.
J. Soc. chem. Ind.	Journal of the Society of Chemical Industry.
Khim. Tverd. Topliva	Khimiya Tverdovo Topliva.
Kop. Naft. Polsce	Kopalnictwo Naftowe w Polsce.
Matières grasses	Matières Grasses.
Min. & Metall.	Mining and Metallurgy.
Min. Mag. (Lond.)	Mining Magazine (London).
Monit. Pétr. roum.	Moniteur du Pétrole Roumain.
Montan. Rdsch.	Montanistische Rundschau.
Nat. Petrol. News	National Petroleum News.
Nature	Nature.
Neft. Khoz.	Neftyanoe Khozyaistvo.
Nickel Ind.	Nickel Industry.
Nov. Neft.	Novosti Neftepererabotki.
Nov. Tekhn. Bur.	Novosti Tekhniki Bureniya.
Nov. Tekhn. Neft.	Novosti Tekhniki Neftedobvicki.
Oel u. Kohle	Oel und Kohle vereinigt mit Erdoel und Teer.
Oil Gas J.	Oil and Gas Journal.
Oil Wkly	Oil Weekly.
Ole, Fette, Wachse	Ole, Fette, Wachse, Seife, Kosmetik.
Olii min.	Olii Minerali.
Paint Mnfr.	Paint Manufacture.
Paint Technol.	Paint Technology.
Petrol. Engr	Petroleum Engineer.
Petrol. Tech. (A.I.M.M.E.)	Petroleum Technology (American Institute of Mining and Metallurgical Engineers).
Petrol. Times	Petroleum Times.
Petrol. World (L.A.)	Petroleum World (Los Angeles).
Petrol. World (Lond.)	Petroleum World (London).
Petrol. Z.	Petroleum Zeitschrift.
Physics	Physics.
Pipe Line News	Pipe Line News.
Proc. Amer. Petrol. Inst.	Proceedings of the American Petroleum Institute.
Proc. Amer. Soc. Test. Mater.	Proceedings of the American Society for Testing Materials.
Proc. Ass. Asph. Pav. Technol.	Proceedings of the Association of Asphalt Paving Technologists.
Proc. Instn mech. Engrs	Proceedings of the Institution of Mechanical Engineers.
Proc. phys. Soc. (Lond.)	Proceedings of the Physical Society (London).
Proc. roy. Soc.	Proceedings of the Royal Society.
Przeg. Chem.	Przeglad Chemiczny.
Przem. Naft.	Przemysl Naftowy.

Abbreviated Title.	*Journal.*
Quart. J. geol. Soc. Lond.	Quarterly Journal of the Geological Society of London.
Rds & Rd Constr.	Roads and Road Construction.
Rec. Trav. chim. Pays-Bas	Receuil des Travaux Chimiques des Pays-Bas.
Refiner	Refiner and Natural Gasoline Manufacturer.
Rev. Comb. liq.	Revue des Combustibles Liquides.
Rev. Pétrolif.	La Revue Pétrolifère.
Rev. sci. Instrum.	Review of Scientific Instruments.
Riv. ital. Petrol.	La Rivista Italiana del Petroleo.
S. Afr. Min. (Engng) J.	South African Mining and Engineering Journal.
Strade	Strade.
Sulz. tech. Rev.	Sulzer Technical Review.
Summ. Ops, Calif. Oil Flds	Summary of Operations, Californian Oil Fields.
Tech. Phys. U.S.S.R.	Technical Physics of the U.S.S.R.
Tekn. Tidskr.	Teknisk Tidskrift.
Terr. Magn.	Terrestrial Magnetism.
Trans. Amer. geophys. Un.	Transactions of the American Geophysical Union.
Trans. Amer. Inst. Min. & Metall.	Transactions of the American Institute of Mining and Metallurgy.
Trans. Faraday Soc.	Transactions of the Faraday Society.
Trans. Inst. mar. Engrs	Transactions of the Institute of Marine Engineers.
Trans. Instn min. Engrs	Transactions of the Institution of Mining Engineers.
U.S. Bur. Mines, Inf. Circ.	United States Bureau of Mines, Information Circular.
U.S. Bur. Mines, Rep. Invest.	United States Bureau of Mines, Report of Investigations.
U.S. Bur. Mines, Tech. Paper	United States Bureau of Mines, Technical Paper.
U.S. Geol. Surv. Bull.	United States Geological Survey Bulletin.
U.S.P.	United States Patent.
World Petrol.	World Petroleum.
Z. dtsch. geol. Ges.	Zeitschrift der Deutschen Geologischen Gesellschaft.
Z. Geophys.	Zeitschrift für Geophysik.
Z. prakt. Geol.	Zeitschrift zur Praktische Geologie.
Z. ver. dtsch. Chem.	Zeitschrift Vereins deutscher Chemiker.

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Geology.

1.* Structural Geology of Wind River Canyon Area, Wyoming. J. R. Fanshawe. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1439–1492.—The Wind River Canyon, which transects the Owl Creek–Bridger uplift, affords good facilities for studying structural basin features of the types common in the Central Rocky Mountain region. The area described is roughly rectangular, about 17 miles long (north to south) and about 8 miles wide.

Stratigraphically, the rocks comprise all formations from Pre-Cambrian to late Eocene in age, except representatives of the Silurian and Devonian. A table and a detailed stratigraphic section includes all the formations present in the Wind River Canyon; these are shown to have an approximate thickness of 15,380 ft. Of this total 2550 ft. is represented by Palæozoic rocks, 1990 ft. by Trias and Jurassic sediments, and the remainder (10,840 ft.) by Cretaceous and Tertiary beds.

Earth movements in the form of Laramide mountain-building forces were responsible for varying results in each part of the area. General outlining of the basin areas occurred with the earlier phases of the regional compression. More intense phases of the Laramide compression followed, and readjustments by warping, folding, and faulting ceased in some areas earlier than they did in others. By mid-Eocene time the formation of basin structures and their peripheral mountain rims had taken place. It is clear that the southern part of the Bighorn Basin has been crowded relatively southward and slightly eastward with respect to the asymmetric Wind River Basin during Laramide time. The relative predominance of one basin over the other has thus led to large-scale movements in the Pre-Cambrian basement complex.

The chief single tectonic feature in the area is the Boysen Fault. This runs nearly east to west for over 10 miles and has a maximum observed stratigraphic displacement of 2500 ft. 3 miles east of Boysen. The fracture dies out gradually at its west end, and is lost in the Pre-Cambrian outcrops of Copper Mountain at the eastern end.

Numerous maps, sections, and photographs accompany the paper. G. S. S.

2.* Geology of Basin Fields in South-eastern Illinois. L. K. Lee. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1493–1506.—The area under review includes parts of Wayne, Clay, Richland, and adjacent counties in South-east Illinois, and is approximately 75 miles long and 30 miles wide. As the axis of the Illinois basin passes through these counties, the new fields have consequently become known as Basin Fields.

The axis has a southward plunge, and the deepest part of the basin in Illinois is in northern Hamilton and White counties. The basin is traversed by an anticlinal belt, which has also a southward plunge amounting to about 400 ft. from northern Richland Co. to Southern Wayne Co. The anticline is a simple structural ridge in the north, but towards the south the belt broadens and produces several anticlinal axes with synclines. Along these axes local reversals occur, on which most of the production is located.

The chief rocks of the area include those of the Chester and the Ste. Genevieve (McClosky) formations.

The most important production in the area is obtained from the Ste. Genevieve Limestone, which is persistently of an oolitic character. Porosity, however, occurs in lenses of varying degrees both laterally and vertically; it is more persistent on the structures than in the synclines, and is also considered to be primary in origin.

The Cypress (Weiler) Sandstone (Chester) also produces in the North Noble field. It is thought that Chester Sandstone production will become more important as development extends northwards.

To July (1939) 692 producing wells had been completed, giving 18,159,275 brl. Other production data are given in tabular form. G. S. S.

3.* Goldsmith Field, Ector County, Texas. A. Young, M. David, and E. A. Wahlstrom. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1525–1552.—Situated near the centre of the Permian basin of West Texas and South-east New Mexico, the Goldsmith Field is one of the many pools located on or near the eastern flank of the major structure known as the Central Basin platform. The limits of the pool have not been completely defined, although the main ultimate producing area has probably now been outlined.

Rocks of Cretaceous, Triassic, and Permian age occur in the field. The Cretaceous is represented by about 80 ft. coarse brown sands (Basement Sand) which lie unconformably on Triassic sediments. These consist of 1500 ft. of the Dockum Group, the upper 1000 ft. made up of red shale and the remainder of coarse red sands (Santa Rosa), and another red shale zone, the base of the Trias.

The Permian beds are divided into four members: Red Silt (100–150 ft. thick), Upper Evaporite, consisting mainly of salt (1200–1400 ft.), Lower Evaporite, chiefly anhydrite (1000 ft.), and the Dolomite section. The lower part of this member is the reservoir rock of the main accumulation of oil and gas.

Structurally, the field is essentially a flat-topped uplift with comparatively gentle dips. The edge of the structure is very irregular, particularly on the east side. "Noses" of varying size are common. Some of these, together with larger features such as the "South Dome," indicate cross-folding at right angles to the main axis extending north-west to south-east.

Production is from a common reservoir of a two-phase type in which the flood-levels are nearly constant. Present data indicate that water-drive is the controlling factor only in the "South Dome." Other portions of the field are under volumetric control.

It is suggested that the porosity of the reservoir is due to sub-aerial erosion and solution during a break in deposition now marked by an unconformity. G. S. S.

4.* Type Locality of Citronelle Formation, Citronelle, Alabama. C. H. Roy. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1553–1559.—The name given to this formation was introduced by Matson in 1916, because of the excellent exposures in the town of Citronelle and, more particularly, because of the presence of plant-bearing clays which he believed to be part of the formation exposed at Lamberts Station, a little south of Citronelle. The fossil plants obtained from these clays were determined by Berry to be of Pliocene age.

Recent work shows that the clays are faulted and overlain unconformably by the sands of the so-called Citronelle formation. There is evidence that the former are at least as old as the Pliocene, and that the sands and gravels which Matson called Citronelle are younger than the clays. It is therefore considered that the so-called Citronelle deposits are Pleistocene in age.

It would seem useless at this time to attempt to give any formational name to these deposits, and the term Citronelle should therefore be dropped. G. S. S.

5.* New Discoveries Stimulate Interest in Ecuador. W. A. Sawdon. *Petrol. Engr*, Oct. 1939, **11** (1), 107.—At present all the oil is produced from the Santa Elena peninsula and 95% of it is obtained from the Ancon field. Recently two 150-brl. wells have been completed in the deeper zone north of the east end of the Ancon field at depths of about 3800 ft.

All the old El Tambo field wells are shallow, except one which was drilled to 4000 ft. The average depth is 1200 ft., and production is from a sand which is probably a continuation of the Socorro sand. The Cautivo field has yielded oil from pits and shallow wells. Again the oil is from the Socorro sand. Similarly, the Carolina field has pits and wells. The wells average 600 ft. in depth.

The Ancon field has been developed in three areas. The shallow wells are 1000–1300 ft. deep, whilst the deep sands are at about 4000 ft. Productivity is erratic and is from fissures in a formation which is about 2000 ft. thick. During 1938 this field gave 2,119,500 brl. of oil. The average gas–oil ratio is seldom less than 500 c. ft./brl. or more than 1000 c. ft./brl. The formations drilled are hard, and details are given of the drilling equipment and methods. The crude is piped to a refinery and loading pier at La Libertad. G. D. H.

6.* Discovery on Inland Slope of Andes Increases Scope of Peru's Activity. W. A. Sawdon. *Petrol Engr*, Oct. 1939, **11** (1), 115.—Practically all the Peruvian oil comes from the coastal fields in the extreme north, but a recent discovery on the eastern slope of the Andes raises hopes of the development of other fields. Last year 83% of the oil came from Negritos, and most of the rest from Lobitos. Negritos gives oil from several areas, and it is piped to Talara. Of the 1842 wells operated in 1938, 92 flowed, 9 were on gas lift, and 34 were used for injection. The rest were pumped. Experimental water-flooding has been tried. Production is from four main Eocene sands: the Verdun, Lomitos, Perinas, and Salinas. In some areas the separation of the last three sands is not always clear. The wells range from a few hundred to 4750 ft. in depth. Information is given regarding the drilling, completion and production methods. The discovery of new productive areas is difficult and geophysics is being used. Block-faulting is common and marks off the various producing areas. Bottom-hole pressures range up to 2700 lb./in.^{2} and the gas–oil ratio is about 350 c. ft./brl.

The operations at Talara are described. Lobitos has seven main horizons, all in the Eocene. The shallower wells were less than 2000 ft. deep, but the new wells are over 4000 ft. The sands are faulted over the whole district and prediction of sub-surface conditions is difficult. Some wells flow, some are pumped, and some are on gas-lift.

Zorritos is the oldest oilfield in South America.

The Aguas Calientes field east of the Andes and at the head-waters of the Amazon has directed attention to vast areas in Eastern Peru and Western Brazil. The first well, 3104 ft. deep, found oil sands at 1021–1262 ft., and the initial production was 750 brl./day on a ½-in. choke. Two wells have been completed, and a third is under way. The area is 2 ml. from the head of the Pachitea River. Accessibility is difficult and equipment has to be taken 3000 ml. up the Amazon. Oil will probably be taken by pipe to Pucallpa on the Ucayali River, 28 ml. from the field.

In areas south and east of Zorritos test wells have had shows in several places. In the south in the Pirin region near Lake Titicaca several wells have been drilled and at least one has given a little oil.

The Aguas Calientes discovery has revived interest in the area round Contamania, near which there are seepages. G. D. H.

7.* Brazilian Government begins Aggressive Exploratory Programme. W. A. Sawdon. *Petrol. Engr*, Oct. 1939, **11** (1), 126, 128.—Three test wells are to be drilled in the coastal region in Bahia north of São Salvador, and a small well with a production of less than 1 brl./day was recently completed near São Salvador. The locations have been made on the results of geological and geophysical work. Virtually all Brazil has been surveyed geologically, and geophysical work has been carried out in the states of Alagoas, Bahia, São Paulo, Parana, and Santa Catharina. During the past 40 years test wells have been drilled in these States, in Rio Grande do Sol, and in Para. The bulk of the work has been in São Paulo, where most of the wells are less than 1000 ft. deep, although one went to 5000 ft.

Attention should also be given to Acré, near the Aguas Calientes field of Peru.
G. D. H.

8.* Recent Developments have Materially Strengthened Eastern Venezuela's Position. Anon. *Petrol. Engr*, Oct. 1939, **11** (1), 130.—Oil is now being shipped from the Quiriquire, Pedernales, and Temblador fields of Eastern Venezuela, and a pipe-line is being built from Oficina to Guanta on the Caribbean. A line is also to be built to Jusepin.

The monoclinal structure of Quiriquire is divided into two segments by a north–south fault. The reservoirs are lenticular and the oil zones 100–1400 ft. thick. Details are given of the drilling and gas-injection practice. About a fifth of the gas production —namely, 5,326,000 cu. ft./day—is returned to the reservoir continuously. It is doubtful whether the gas is moving uniformly in all the lenticular sand bodies in the producing section.

Initial pressures at Pedernales are above hydrostatic, and a number of the wells are off-shore. Temblador is on a long, narrow structure. Gas production and drilling details are given for these two fields.

Oil has been obtained from the Uracoa well and also from the El Tigre wells between Temblador and Oficina. A small pumper was completed at Merey, south-west of El Tigre, and at Areo a little oil was found. Some oil was obtained in the Yopales well.

The Guanoco and Orocual wells were closed in several years ago, and the area east of Caripito and Maturin has been widely prospected without giving commercial oil production. The results obtained with other wells are given. G. D. H.

9.* Oil and Gas Content of Saratov–Left Volga Bank Region. V. Ya. Avrov. *Neft. Khoz.*, June 1939, **20** (6), 11–13.—So far only near Ozinki has oil been found in commercial quantities. In other parts there are indications—namely, bitumen in certain Carboniferous strata of the northern and north-eastern parts of Rayon, and the mineral-sulphur springs near Chapayevki (former Stolypin mineral springs).

Existence of gas in Saratov–Left Volga Bank rayon has been known since 1906, when the Melnikov gas well was sunk, the gas consisting mainly of methane with a relatively high N and He content. As crude oil has been found in adjacent Kuibyshev, Buguruslan, and Saratov–Right Volga Bank rayons, a survey of Saratov–Left Volga Bank rayon is deemed imperative.

The geological structure of rayon is discussed. Prospects of oil are very good as the structure is similar to that of the Emba field. Confirmations were obtained by exploration wells, but oil strata might be of local character.

As an analogy to Samarskaya Luka it is assumed that in Pugachov and Chapayevki region commercial oil and gas accumulations might be found in the Carboniferous at depths up to 1500 m. The possibility of oil occurrence in the Palæozoic and Devonian and the origin of gas are discussed. Helium seems likely to occur in the Palæozoic, and exploration of these horizons is advocated. L. R.

10.* Combustible Gas Seepages in River Sarbaya Basin. A. K. Banov. *Neft. Khoz.*, June 1939, **20** (6), 18–19.—In Kinel-Cherkassy and Podbyelsk rayons of Kuibyshev district in the basin of the upper part of Sarbaya river many gas exits have been located. The geologic structure of the territory is examined. No striking structure types are found, only widely developed microtectonic phenomena. Gas seepages have been detected over almost all the rayon, but are for the greater part situated in the north-eastern region. Gas yields are insignificant, probably varying up to 5 cu. m./sec. Gas compositions of thirteen locations are tabulated. All are methane gases with a high N content, whilst in one case almost pure N was found. Content of heavy hydrocarbons varied between 0·1 and 0·8%. The nature of the gases is not known, but they undoubtedly come from greater depths, having migrated from gas-carrying strata, possibly together with oil, and permeated a horizon carrying water, with which the gases come to the surface.

It is concluded that the gas leakages in the Sarbaya river basin have a great practical importance and that exploration work should be accelerated. L. R.

11.* Second Conference of Geologists and Geophysicists of the Y.P.F. Anon. *Bol. Inform. Petroleras.*, Aug. 1939, XVI (180), 3–21.—This conference was opened on 17th April, 1939. Fourteen papers were read, and followed by discussions. Diagrams showing the timing and electrical characteristics of two borings at Comodoro Rivadavia, in connection with de Luca Muro's paper, are of particular interest.

H. I. L.

12.* Discovery of Petroleum at Pirin, Peru. Anon. *Bol. Inform. Petroleras*, Aug. 1939, XVI (180), 57–58.—In the course of drilling carried out by the P.W.D. of Peru in the reserved zone of Lake Titicaca, petroleum was obtained from well RH 2, at a depth of 56·48 m. The oil gushed out to a height of 2 m. and the daily output has been 100 brl. This oil-field is the highest in the world, its altitude being between 3800 and 4000 m. The well itself stands at 3920·50 m. H. I. L.

13.* Illinois Reserves Reach Half-Million Barrels. G. Triplett. *Oil Wkly*, 5.6.39, **93** (13), 66.—The author, in discussing Illinois reserves, reports an ultimate yield of 461,810,000 brl. of crude oil, of which 40,112,385 brl. have already been produced.

Reserves of new fields in Illinois are detailed in a table. Kentucky and Indiana are also discussed, but the interest in the latter reserves is not so strong as in that of Illinois. A. H. N.

Geophysics.

14.* Electrical Well-logging. Houston Geological Society Study Group. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1287–1313.—This paper is concerned principally with the effects of abnormal conditions on the S.P. and resistivity curves. In the case of the S.P. curve, these may include formation pressures equal to or greater than the hydrostatic head due to the fluid in the well, and drilling fluid with a salinity equal to or greater than the salinity of formation brines. That care must be taken in the interpretation of these curves is emphasized by the fact that it is possible for no anomaly to be shown in front of a porous formation. Resistivity measurements may yield misleading results, on account of penetration of drilling fluid into the strata, abnormal salinity of the drilling fluid, and the presence of relatively large amounts of colloidal matter in the more permeable formations.

Correlation may be attempted in three different ways: short-distance correlation on a field, regional correlation, and structural correlation. The application of electrical logging to structural work in the Gulf Coast has shown that, contrary to previous ideas, the deep structures are reflected in the surface beds.

The typical reaction of fluids in various formations is discussed, and it is shown that it is necessary to distinguish between clean, dirty, and cemented sands. Thin layers of salt have a similar effect to other resistant rocks, but, if the salt is readily dissolved by the mud, enlargement of the diameter of the hole will cause a fall in resistivity.

In addition to correlation, electrical logging is being applied to the determination of the fluid content of sands and to the measurement of permeability. S. E. C.

Drilling.

15.* Determining Sand Thickness in East Texas Wells. H. L. Flood. *Petrol. Engr*, Sept. 1939, **10** (13), 45.—The paper describes the steps taken by one East Texas operator to determine accurately the total thickness of oil-bearing sand in the Woodbine formation in order to provide a formula for production potential. The decision was taken after the rotary equipment was moved away, and as it was not considered economical to use cable tools in the formation, the reversed-oil drilling method was used.

In this method there are two trucks; the first is the hoist truck, and the second is the pump truck. Oil is used as a drilling fluid. An electric motor drives the 2-in. or 2½-in. drilling string, at the end of which is attached a special tubing bit, by means of a hexagonal kelly and a worm drive. A 7½-h. p. electric motor was sufficient to drill at a rate of 5 ft./hr., and provided a safety means, as the motor stalled long before undue stresses developed in the tubings. The ammeter provided a most sensitive torque indicator. Reversed circulation of the oil is used to impart high velocities, and hence high lifting power to the oil.

Electrical logging determined the sand thickness, and a formula for the proration factor was developed based on this and other information. A. H. N.

16.* Proposed Layout for a Four-Engine Rotary Rig Drive. F. E. Bruhn. *Petrol. Engr*, Sept. 1939, **10** (13), 51.—Four Diesel engines are arranged to provide ample flexibility for all combinations of pump and table speeds. The four-engine drive is proposed to eliminate some of the many disadvantages of the two-engine rig, which is the predominating type at the present time. A drawing shows clearly the layout of the unit, with clutches and pulley drives being arranged to connect any or all the engines to any member of the rotary rig.

It is believed that the increased flexibility, increased ease of rigging-up and moving from one location to another, and the high maximum horse-power output available make this drive extremely desirable for drilling to depths of 3000–6000 ft.

A. H. N.

17.* Oil-Well Cements—Chemical Composition and Sensitiveness to Additions of Water. S. L. Meyers. *Petrol. Engr*, Sept. 1939, **10** (13) 100.—Prof. Solacolu has made a study of the effects of adding large quantities of water on the strength of different portland cements, and has thus shown the relationship existing between the chemical composition of the cements and their sensitiveness to large addition of water.

In this report a description is given of the methods adopted in the research, the control steps taken, and the results attained. It appears that high-iron cements are sensitive to increases of water content. High-alumina cements, on the other hand, appear to be relatively insensitive to water changes.

The effects of temperature are also studied, and results of the research are presented in both tabular and graphical forms. A. H. N.

18.* Preliminary Design of Drilling Barge for Deep-Water Prospecting. Part I. R. H. Rogers. *Petrol. Engr*, Oct. 1939, **11** (1) 21.—At the present time under-water drilling is done by equipment mounted on submersible barges or on platforms or decks constructed on pile foundations. This system of drilling from a submersible barge affords a compact, self-contained, mobile drilling unit mounted on a fixed working-platform, a fact which cuts down drilling costs, as it is not necessary to dismantle the rig before moving on to a new location. The disadvantages attending the system are: (1) the limited depth of water in which it can be worked, (2) the necessity of working on a level bottom, with consequent increase in drilling costs.

Drilling from a platform on a pile foundation has exactly the opposite attributes discussed with regard to drilling barges—*i.e.*, high dismantling cost, limit to depth much larger, and no necessity to level the bottom.

It would appear that the ideal drilling rig should combine the advantageous characteristics of both the submersible barge and the pile-founded platform. The author proceeds to design a floating drilling rig with telescopic legs, endeavouring to fulfil the following list of conditions. The rig should:

(1) be capable of drilling in shallow or deep water (9–50 ft.);
(2) offer an adequate working-platform having all drilling equipment arranged for efficient drilling;
(3) be mobile, either self-propelled or not;
(4) be able to ride out reasonably bad weather;
(5) have ample storage facilities;
(6) have adequate transverse stability;
(7) have adequate longitudinal stability;
(8) offer a dry working-platform in bad weather;
(9) be capable of being easily removed after completion of well.

In this part of the paper the author deals with the general description of the equipment and with five items in the design method—*i.e.*, weights, displacement, trim, longitudinal stability, and transverse stability. A. H. N.

19.* Record of Penetration Rate Should Aid in Drilling-Time Studies. H. L. Flood. *Petrol. Engr*, Oct. 1939, **11** (1), 31.—To control and maintain the efficiency of drilling, various instruments have been devised, such as the weight indicator, torque recorder, table-speed tachometer, instruments for measuring deviation of crooked holes, electrical logging, mud analysers, and, more recently, instruments that will warn of the imminence of oil and/or gas in the formation being drilled.

One of the most recent of such instruments is one which records the rate of penetration. The principle of the instrument is to record the weight of the column of liquid of the height of the rotary swivel: as the hole is deepened, this height is recorded on a chart revolving at a known rate, and thereby provides automatically a record of the number of feet of hole drilled per unit time. Thus the instrument consists of a fluid reservoir attached to the swivel, a length of rubber hose, and a special recording low-range pressure gauge. The fluid may be clear water or an anti-freeze solution in cold water. An important accessory is a celluloid template used to analyse the charts and translate the records to rates in terms of feet/min., and feet/hr. A. H. N.

20.* Modified Form of Slim-Hole Drilling for Exploration Wells. M. A. ap Rhys Pryce. *Petrol. Engr*, Nov. 1939, **11** (2), 29—32.—" Slim-hole " drilling describes the drilling of holes to moderate depths to obtain geological information. If the slim-core-hole proves the presence of oil, the operator makes the capital outlay required for the full-size exploitation holes. If, on the other hand, no oil is found, only a minimum amount of capital has to be written off to exploration. The hole is not suitable to be put on production. A method used in South America, however, permits deep tests to be converted into producing wells in the event of oil being found.

The dangers of slim-hole drilling, due to twist-offs, etc., are discussed, and the practices in Trinidad are especially quoted for data on the mud fluid, pressures, velocity of mud, weight on bit, etc.

An analysis is made of the cost of drilling a slim-hole and " streamline drilling " as compared with full-size hole. Approximately 48% less material, principally shale or rock, must be cut and removed from the former than from the latter. Other savings are also given.

A typical well drilled under these " streamline exploration " conditions cost no more than $100,000 at normal rate of exchange, even including transportation. This cost compares favourably with most South American wildcats, which frequently cost a quarter of a million dollars or more, in similar circumstances. A. H. N.

21.* " Slant-Hole " Drilling of Wells Employed in Argentine. Anon. *Petrol. Engr*, Nov. 1939, **11** (2), 80.—A description is given of directional-drilling methods adopted to exploit oil-bearing formations beneath the Gulf of San Jorge. The wells are the first of their kind to be drilled in the Argentine Republic. A. H. N.

22.* Carelessness may be the Cause of Accidents on Drilling Rig. R. G. Bennett. *Petrol. Engr*, Nov. 1939, **11** (2) 140.—The causes of certain accidents in drilling are discussed, chief amongst them being the driller with mania for speed who can endanger the lives of an entire crew by a laxity in safety precautions. Although the paper is written in a rather light vein, it is a serious treatment. It particularly deals with cases, such as exist in South America, where drilling crews are composed of unskilled or semi-skilled labour, trained by a foreign driller in whom they place all confidence. A. H. N.

23.* Deepen Old Producer in North Louisiana Field. G. Weber. *Oil Gas J.*, 7.9.39, **38** (17), 28.—Much of this short article is concerned with the future programme of an interesting well in the Lisbon field. An improved gas-detector will be used to signal the driller at the first indication of an increase in gas content of the mud. It works as follows :—

The instrument consists of a baffle tank held under vacuum by a steam jet. The mud flows over the baffles, and any gas in solution is drawn to the surface and removed, together with air to the electrical-combustion detector. There a hot-wire filament set on a sensitive Wheatstone bridge circuit causes a film combustion, known as the skin effect, immediately around the filament. The increased temperature due to the gas combustion raises the electrical resistance of the filament, throwing the circuit out of balance, and recording the effect in the galvanometer reading and the horn signal. By varying the resistance in the Wheatstone bridge circuit, the instrument can be made to detect gas increase over a wide range. By means of successive readings, the operator can determine whether the gas content in the mud is increasing, remaining constant, or decreasing, and can thus check the walling action of mud after gas horizons have been drilled. A. H. N.

24.* Metals in Drilling—The Rotary Chain. W. L. Nelson. *Oil Gas J.*, 7.9.39, **38** (17), 48.—This is the third article of a series which is designed to cover the industry from oil-sand to filling-station. Recommendations are given in tabular form, and are taken from various metal and equipment manufacturers. A. H. N.

25.* Continental Completes World's Deepest Washing-Over and Cutting-out Job. P. Reed. *Oil Gas J.*, 28.9.39, **38** (20), 34.—The deepest washing-over and cutting-out

operation ever undertaken on any test in the world was recently successfully completed at Continental Oil Co.'s No. 1 Well in Western Oklahoma, at a depth of 14,000 ft.

In the method employed, a wash-over string, equipped with a rotary shoe having a slightly larger outside diameter and a slightly smaller inside diameter than the drill-pipe cutter is circulated and rotated over the stuck drill-pipe. After the stuck drill-pipe has been washed over for the desired distance, the wash-over string is withdrawn from the hole and the rotary shoe is replaced by the drill-pipe cutter. The wash-over string is then run back into the hole and the cutter is lowered over the stuck drill-pipe. A cut is made a short distance below a tool joint.

The wash-over operation and cutting procedure adopted in this particular instance are detailed and illustrated in the paper. A. H. N.

26.* Combating Electrolytic Corrosion of Gas-Well Casing by Insulation. W. E. Huddleston. *Oil Gas J.*, 28.9.39, **38** (20), 40.—Leakage of stray electric currents was detected on a large number of wells in the Panhandle area of Texas, and corrosion of the casing from this source has been determined. Elimination of further trouble has been effected by insulating the casing. A diagram depicts the interaction of gas-well casing and lateral lines in the field, and shows surface lines receiving enormous " pick up " in close proximity of the wells.

An outline is given of the methods used in insulation and of detection.

A. H. N.

27.* Metals in Drilling—Rotary Equipment. W. L. Nelson. *Oil Gas J.*, 28.9.39, **38** (20), 58.—This is the fourth short article in the series, and gives the approximate analysis, approximate physical properties, and heat treatment of metals used in the rotary table, pinions, swivels, shaftings, and gears. The steels listed have been recommended by various manufacturers, and a reference list is appended to the article.

A. H. N.

28.* Metals in Drilling—Drilling Hoists. W. L. Nelson. *Oil Gas J.*, 5.10.39, **38** (21), 54.—In this paper specifications and suggestions are taken from current literature and from manufacturing company bulletins. Approximate analysis, approximate physical properties—*i.e.*, yield point, elongation and Brinell hardness, and heat-treatment suggestions are given for catheads, brake-rims, brake- or clurch-bands, drum flanges, sprockets, bearing boxes, shafting and drive bushings for draw-works and drilling hoists are tabulated. A. H. N.

29.* Drilling Equipment Accounts for Illinois Completion Rate. Anon. *Oil Gas J.*, 26.10.39, **38** (24), 62.—Rigs of all types have drilled more than 5,000,000 ft. of hole in the Illinois fields during the past year.

A detailed description is given of many practices and drilling methods employed in the basin.

The paper is one of a series in an " Illinois Basin Section " of the *Oil and Gas J.*

A. H. N.

30.* Hard Formations Increase Well-Drilling Costs. H. F. Simons. *Oil Gas J.*, 26.10.39, **38** (24), 129.—Expense due to unusual wearing of rotary and cable-tool bits is of such importance that the subject of hard formations is reviewed with special attention. The paper deals mainly with conditions encountered in penetrating quartzite and other hard formations which retard drilling operations to an unusual extent.

During the early stages of development in a field, bit costs are often high, but they are reduced as the contractor and drillers become acquainted with the formations and are thus able to obtain the maximum footage per bit. A point is reached, however, where the number of bits cannot be further reduced. Any difference in the number of bits used on the various wells then becomes dependent on the type of surface machinery used and the local variations in geologic conditions. A. H. N.

31.* Metals in Drilling, Part 7, Crown and Travelling Blocks. W. L. Nelson. *Oil Gas J.*, 2.11.39, **38** (25), 49.—Recommendations and specifications are taken from

authorities, manufacturers, and fabricators of steels for crown and travelling blocks. The approximate composition, yield point, elongation, Brinell hardness, and suggestions for heat treatments are given for sheaves (six types), bearings and pins (three types), pins (two types), and shafts (three types). The significance of Brinell hardness in terms of machinability is discussed in the paper, which ends with a list of references. A. H. N.

32.* Simultaneous Electrical Logging and Drilling. P. Reed. *Oil Gas J.*, 17.11.39, **38** (27), 93.—Five wells have been drilled with an electrical record of formations being made while the drill stem was making hole. The first four wells were in proven areas, whilst the last one drilled was a wildcat. All wells were re-surveyed after completion by the conventional method.

The equipment consists of specially constructed kelly, drill-pipe, tool-joints, and drill collars. Recording and control equipment is centred to a large extent in a house trailer. Only the front part of the trailer is required for this purpose, the remainder being fitted as living accommodation for the observers. The recording and control equipment in the trailer is connected to associated parts on the derrick floor through a set of electrical weatherproof cables.

The kelly has been constructed to contain an electric cable, which connects to a brush-box mounted at the top immediately below the swivel. The electrical circuit for electrical logging is established through the brush-box to the bit by means of a section of cable built into each joint of drill-pipe. With the exception of the cable, the drill-pipe is entirely standard. Special joints are designed which, when screwed together, the terminals engage and establish contact and insulate the circuit from the mud stream.

To permit the bit to function as an electrode, a specially designed drill-collar insulates it from the drill-pipe. A testing switch of ingenious design is incorporated in the circuit. A. H. N.

33.* Collapsing Pressure of Oil-Country Tubular Goods. W. C. Main. *Oil Gas J.*, 17.11.39, **38** (27), 102. Paper presented before American Petroleum Institute.—This is a new approach, from a theoretical standpoint, to the problem of collapsing pressures of oil-country tubular goods.

The paper points out the limitations of present formulas, and suggests a method whereby the two existing types of rational formulas might be combined to give a result which is also rational, and will apply throughout the entire range of tube proportions regularly used for casing, drill-pipes, and tubing.

Although the equation which is developed by this method is cumbersome, it should aid in clearing up some of the mistaken notions on this problem, and help to straighten out the controversy on safe setting depths of oil-country tubular goods from a collapsing pressure point of view. A. H. N.

34.* The Carter Pressure Core-Barrel. Ben W. Sewell. *Oil Gas J.*, 17.11.39, **38** (27), 140. Paper presented before American Petroleum Institute.—A pressure core-barrel is a coring device which differs from conventional core-barrels in that the core, after having been cut, is sealed within a chamber and brought to the surface under pressure.

The primary purpose of such a core-barrel is to prevent the loss of the contents of the core due to expansion as the pressure surrounding the core is reduced, thus permitting a more accurate determination of its original content:

A discussion of the entire field of pressure-core applications is beyond the scope of this paper; the more general uses include the following:

1. A more certain determination of reservoir content than is furnished by the conventional non-pressure-type core-barrel.
2. Location of gas-caps and determination of content.
3. Studies of oil, gas, and water gradients through a producing zone.
4. Studies in well spacing.
5. Studies of oil remaining in place in depleted fields by drilling and coring intermediate wells.

6. Studies of various methods and rates of production by working on cores while cores are under pressure.
7. Studies of contamination of cores.

Briefly, the Carter pressure core-barrel may be described as a conventional core-barrel, containing a third tube between the inner and outer barrels. This third tube is provided with valves at both ends and an arrangement for lifting the inner barrel containing the core up into it, after which the valves are closed. All these operations occur at the bottom of the hole. A. H. N.

35.* Porous Formations Sealed by Stage-Cementing Deep Wildcat. H. F. Simons. *Oil Gas J.*, 23.11.39, **38** (28), 38.—The Continental Oil Co.'s No. 1 Proctor, Oklahoma, currently the deepest drilling test in the world, recently began having trouble with caving shale. Circulation could not be maintained with mud heavy enough to stop caving of the shale at the bottom of the well. The fluid was escaping into the formation back of the liner set from 9712 to 14,491 ft. whenever it was " heavied " to stop caving.

The problem was successfully solved by an unusual squeeze-cementing job, which consisted of placing 665 sacks of cement in eleven batches behind the liner, with one setting of a Baker Type K cement retainer at 9708 ft.

Full history of the well and details of the squeeze cementing job are given. A. H. N.

36.* Drilling to Determine Illinois Daily Output. Anon, *Oil Wkly*, 5.6.39, **93** (13), 53.—It is pointed out that production in Illinois is a function of well completion, as Illinois is a pumping area, and therefore the daily output varies with the number of wells completed. The practices in the Loudon area are described, where wells average 1650 ft. and may be drilled in 100 hr. A. H. N.

37. Oil Possibilities of Deeper Beds in Illinois Basin. A. H. Bell and G. V. Cohee. *Oil Wkly*, 5.6.39, **93** (13), 58.—The authors give the oil possibilities in deeper beds in the Illinois Basin. A table of wildcat wells drilled in the Devonian or deeper sands since 1936, with details of depths, tests, and remarks is given. The Devonian–Silurian limestone appears to have good possibilities of oil production on favourable structures in the Illinois Basin. A. H. N.

38.* Large Oil Volume Found Per Drilling Dollar and Foot. W. H. Strang. *Oil Wkly*, 4.9.39, **94** (13), 16–18.—An analysis of discovery rates and drilling expenditures in the United States during the 4-year period ended 31st December, 1938, reveals that the operator with average success found $3·89 worth of oil for every dollar spent for drilling activities, and 29·8 brl. for every foot drilled.

The difficulty of obtaining accurate information upon the total expenditure of the drilling-producing industry during this or any other period precludes the possibility of an actual profit calculation on finding and producing oil, but it is certain that high production costs, slow rates of investment return, and burdensome taxes whittle the imposing $3·89 figure down to an actual profit in the neighbourhood of a few cents per dollar spent.

Figures in tabular and diagramatic forms are given for the large reserves found per foot drilled.

In two States the return was not sufficient to repay the expenses of drilling alone, production and other costs being entirely a loss. A. H. N.

39.* Derricks Being Assembled Horizontally on Ground and Raised as Unit. F. B. Taylor. *Oil Wkly*, 4.9.39, **94** (13), 24–26).—The new method for assembling steel derricks is given, and records show that in the fields where this method has been used the procedure is another achievement in the saving of drilling time.

The derrick is fabricated in five sections, each bolted and welded as a unit. Assembly bearings joint the sections. When completely erected the derrick has a height of 87 ft., sufficient to care for either regular shallow or slim-hole equipment. When the

five sections are assembled on the ground and the work is checked, the derrick is jack-knifed into a vertical position by the draw-works. The joint of the jack-knife which serves as the bearing for the lifting operation is at the front end of the base. To dismantle, preparatory to moving, the process is reversed.

The paper is well illustrated by photographs of the different stages of the operation, and each step is described in detail. A. H. N.

40.* Ideas Used to Solve Field Employee Work Schedules. B. Mills. *Oil Wkly*, 4.9.39, **94** (13), 28.—The paper presents a varied programme of work to meet the provisions of Wages and Hours Act of the U.S.A. The practices of various companies and employees are given as typical examples for provisions both for weekly schedules and for overtime work.

Weekly working schedules for drilling crews are more difficult to make and observe than are those for ordinary field-men. Much of the miscellaneous field work is carried out on a straight eight-hour daylight basis, whilst drilling hours are continuous.

Oil companies and drilling contractors pay exceptionally high wages, the average for each group being above the average for manual labour in any other major industry. A. H. N.

41.* Beware of Derrick Floor—Drilling's Danger Spot. J. I. Powell. *Oil Wkly*, 25.9.39, **95** (3), 30.—While admission must be made that the safety situation in oil-field operations has shown a continued improvement in the past ten years, it is not, however, an indication that the much-desired objective has been reached.

The fact that more than one-third of the accidents occur in the area of the derrick floor indicates the need for greater prevention work. Tables and analyses are given for the frequency of accidents, relative severity of accidents, and the distribution, frequency, and cost of 1000 oil-field accidents. The derrick floor looms on the top in the frequency and total cost of accidents.

It is suggested that oil operators, particularly those who do not have an organized safety programme at this time, should develop a training programme based on the findings of this analysis. A. H. N.

42.* Drilling Gains as Shutdowns and War Strengthen Markets. L. J. Logan. *Oil Wkly*, 16.10.39, **95** (6), 15–17.—Decrease of completions in September reflects the interruption in the starting of new wells by oil-field shut-downs in six Mid-Continent States during the latter half of August.

Data are supplied on the activities of oil-fields in September, and comparisons are made with other periods. A. H. N.

43.* First Mississippi Drilling was Back in 1903. W. H. Strang. *Oil Wkly*, 13.11.39, **95** (10), 56.—An interesting history of wildcat drilling in Mississippi is presented. Although Mississippi did not enter the list of commercial oil-producing States until 5th September, 1939, when the Tinsley dome in Yazoo County was proved productive, exploration for oil and gas within its boundaries began as long ago as 1903. Nevertheless, two-thirds of the 300 wildcat failures drilled in the State have occurred in the past 9 years.

A summary is given of the drilling activity in Mississippi, non-productive wells drilled as well as the productive ones, from 1903 to 1st November, 1939.

The geology of the fields is briefly discussed. A. H. N.

Production.

44.* Mississippi Well is Flowing Oil. N. Williams. *Oil Gas J.*, 7.9.39, **38** (17), 25.—A report on oil well No. 1 Woodruff is given which shows that commercial oil production in Mississippi seems almost a certainty. A. H. N.

45.* Fifteen-Day Shutdown Period used to Good Advantage. Anon. *Oil Gas J.*, 7.9.39, **38** (17), 42.—Production engineers and operators are now able to review field

conditions during the 15-day shutdown of all important oil-pools in Texas, Oklahoma, Louisiana, Kansas, New Mexico, and Arkansas. They are also witnessing the first effect of the shutdown on wells that have resumed production. Several months must elapse before it is possible to state accurately the results in all instances, but general observations are summarized in this paper.

The period of the shutdown was from 16th August to 1st September, and was unprecedented—the shutdown was complete with the exceptions of wells which were making abnormally large quantities of water, which might be permanently injured as producers.

Bottom-hole pressures were taken by several companies, and, as may be expected, the pressures increased over the period; but at least two months must pass before definite conclusions can be reached.

The operations in the fields during the shutdown period are summarized.

A. H. N.

46.* Electrically Driven Powers and Central-Generating Unit Feature of Texas Leases. J. C. Slonneger. *Oil Gas J.*, 14.9.39, **38** (18), 42.—The combination of electrically driven geared powers and a central generating plant is unique in the oil industry. In the first installation of this character, which differs from the usual central generating plant for oil-well pumping in general design, an effort has been made to take every advantage offered by central generating-plant pumping and to reduce to a minimum the difficulties arising from oil-well loads.

The problem was to pump seventy-seven wells, 2700–2800 ft. deep, and varying in output from 60 to 200 brl./day, in a field which promises long life, but which may exhaust its gas supply. It was desirable to keep the initial power-plant investment at a minimum and provide for its orderly expansion, so that in the entire life of the field the power-plant would never be out of proportion to the power needed.

The paper gives the solution adopted for this problem and discusses the layout of the equipment and its operation. A. H. N.

47.* Recovery Programme in Naval Reserve Field. H. F. Simons. *Oil Gas J.*, 14.9.39, **38** (18), 56–58.—Taking advantage of the similarity and location of the wells in the Naval Reserve of Oklahoma, owners of these wells have established an unusual community re-pressuring project, with each company in the field sharing ownership and expense. The project started in 1937, 5 years after the discovery.

The operation of, and the results obtained from this enterprise are outlined. Although troubles have been met in the winter, due to gas hydrates freezing and blocking the line, the advantages outweigh the difficulties. Freezing troubles have now been partly eliminated by injecting anhydrous ammonia; methanol has been injected in emergency cases. A. H. N.

48.* Conservation and Proration Analysed. J. E. Pogue. *Oil Gas J.*, 28.9.39, **38** (20), 17.—The paper is a part of a statement by Dr. Pogue concerning the economical aspects of the problems of conservation measures for "maximizing the effective use of reservoir energy in the production of oil, despite the contrary influence of the rule of capture." The rule of capture subjects the industry to activation at the source, and widens the range of production costs, impairs the functional aspect of price, creates instability, and at the same time inhibits maximum recovery.

To counteract these tendencies the reservoir energy should be conserved and most efficiently utilized by regulating the flow of oil-pool to optimum rates, or less, in conformity with engineering principles, even though the pressures of supply may be contrary to this objective.

The conflict between these two rules is analysed. A. H. N.

49.* Re-Cycling Trend Expands with Bigger Gas Reserves. G. Weber. *Oil Gas J.*, 5.10.39, **38** (21), 36–39.—This is the first of a series of papers to appear in the *Oil and Gas J.* which will deal with design, construction, and operation practices, a discussion on gas-testing methods, and vital legal considerations which must be given to the problem of gas condensate fields.

This paper defines the terms employed, discusses plant operations and methods of processing, and presents a survey of gas condensate fields in Texas and Louisiana.
A. H. N.

50.* Injection of Gas into Oil Reservoirs. H. L. Baldwin. *Oil Gas J.*, 5.10.39, **38** (21), 46.—The principles of injection and flow of gas in oil reservoirs are given. The importance of permeability tests is the first point to be stressed.

A general sketch is made of the flow of heterogeneous fluids, gas and oil, in porous media, and the effects of connate waters are taken into account. These principles are applied to secondary recovery methods in a general manner—no complex or detailed formulæ are given.

The practical application of gas injection under three headings—pressure maintenance, gas-drive, and pressure restoration—is discussed. These are distinguished by the relative oil saturation remaining at the time of application and by the method of application. The term re-pressuring is often applied to either or both of the latter two types.

The ideal type of reservoir for pressure maintenance is one with a sand section of high horizontal and vertical permeability, a large structural closure, an initial gas-cap, and an effective water-drive.

Gas-drive is generally applied at a time when reservoir pressures are a low portion of the original and the per cent. liquid saturation has been reduced to values so low that appreciable permeability to gas is present and the oil must be moved more by a viscous drag than by a displacement mechanism.

Among the advantages of pressure restoration as compared with gas drive is a decrease of viscosity of oil through solution of gas, a minimizing of the effects of permeability differences by forcing gas to enter the tighter portions of the sand, and a partial correction of irregular water-encroachment conditions. A. H. N.

51.* Testing and Sampling Methods Used on Condensate Wells. G. Weber. *Oil Gas J.*, 12.10.39, **38** (22), 48.—The lack of sufficient data on the behaviour of gas in the retrograde pressure range prevents accurate calculation of plant-operating conditions and expected yields, which is possible at lower pressures where simple gas laws apply. Until the time when enough is known of the behaviour of gas at higher pressures to support accurate computation, the basic data on re-cycling operations must be obtained from actual well and laboratory tests.

Methods of sampling and testing gas under high pressures are discussed, including Bureau of Mines and Texas Railroad Commission tests. Drawings are given to illustrate the apparatus, and curves are discussed to typify the results obtained.
A. H. N.

52.* Novel Method of Suspending Rod-Lines. Anon. *Oil Gas J.*, 26.10.39, **38** (24), 126.—Both lime- and sand-wells in the Illinois basin decline rapidly to the point where they must be put on the pump soon after completion, and consequently one of the major producing problems in the area is economical lifting of the oil, by mechanical means. The Pure Oil Co., the oldest in experience in the area, has adopted the centrally geared power-and-jack method of obtaining its production.

One of the most unusual features introduced is a new type rod-line carrier which reduces friction losses and increases the efficiency of the pull-lines. The new carriers are constructed from junk sucker rods and hardwood blocks. As the rod-line travels, uprights and a swinging member are made free to travel with it, and a supporting block is forced to move in a straight line, with the rod-line being fully supported throughout its entire travel. The wood is lubricated at first, but a glazed surface develops, which makes an excellent bearing, wears well, and is practically frictionless. These bearings are much more efficient than the sliding of the rod back and forth across the doll-head, and in actual use have required less greasing and care.
A. H. N.

53.* High-Pressure Development in the Bradford Field. J. P. O'Donnell. *Oil Gas J.*, 2.11.39, **38** (25), 50.—While it has been recognized for some time that high pressures result in earlier and greater ultimate recoveries in water-flooding, operators in the

Bradford field of Pennsylvania have shown but little disposition to increase substantially the pressure of their input water. This is due to the fact that practically all properties already under development are equipped to handle comparatively low pressures, and that the water-lines and tubing would not withstand the higher pressures if the plants could supply them.

The author discusses the limits of pressures it is possible to use. Theoretically, pressures in excess of 1 lb. of pressure at the sand face per foot of overburden would lift the overburden and result in entirely by-passing the sand. A. H. N.

54.* Compression Requirements for Re-Cycling. F. W. Laverty. *Oil Gas J.*, 2.11.39, **38** (25), 32.—Recently developed practices in high-pressure gas-fields of processing the gas through the retrograde condensation range to recover a distillate, and then to return the residue to the producing horizons involves boosting gas pressure to something above the formation pressure. Such pressures commonly range up to 5000 lb./sq. in.

The economics of such a process is governed by the power required and its cost. The power required depends on: (1) the volume of gas to be handled; (2) suction pressure to the compressor; and (3) discharge pressure from the compressor.

The volume to be handled is a function of field conditions, which can only be determined by field tests. The suction pressure is usually determined by the recovery process. The discharge pressure is determined by the pressure in the sand and the friction losses between the compressor and the sand. The properties of the gas to be handled determine the horse-power required to a limited extent.

The author derives expressions and gives curves for the calculation of horse-power under the extreme conditions obtaining in retrograde condensation range.

A. H. N.

55.* Applied Conservation Assures Magnolia Large Recovery. G. Weber. *Oil Gas J.*, 9.11.39, **38** (26), 12.—The Magnolia field, Arkansas' largest oil reserve, is nearing the completion of its drilling development. Due to compilation of unusually complete engineering data and geologic records, much information regarding its future importance can now be determined.

The field provides an outstanding example of the benefits of strict conservation principles. It is thought that the wide well-spacing, adequate casing programmes, uniform drilling, and completion methods and equitable proration adopted in this field assure maximum recovery over long flow period.

Conservative estimates place the recoverable petroleum reserves from the Magnolia field at 180 million brl., 292,000 million cu. ft. of gas, and 628 million gal. of natural gasoline and butanes. The estimated productive area is only 4000 acres, which fact renders the estimates unusual.

Discussion of the estimated reserve factors and withdrawal rate are given, together with a plot giving production, bottom-hole pressure, and gas/oil ratio. A. H. N.

56.* Acreage Given More Weight in Texas Proration Methods. D. H. Stormont. *Oil Gas J.*, 9.11.39, **38** (26), 20.—Operators in Texas fields are now favouring the trend to wider spacing of wells than was adopted hitherto, and are attaching more importance to acreage in deriving their proration formulas. Increasing numbers of wells and the downward trend in well allowables leave operators but little choice. The generally greater depths that holes must be carried, with the attendant higher cost of drilling, also influence the trend towards larger proration units and wider well spacing.

Figures show that prior to 1929 only about 11% of Texas fields were developed on spacing patterns of 20–40 acres; during the period between 1929 and 1939 less than 46% of the fields were drilled on this basis; but so far this year (1939) about 90% of the new field rules called for 20–40-acre spacing pattern.

Spacing patterns and proration units now in general use are discussed.

A. H. N.

57.* Advanced Engineering Ideas Used in High-Pressure Field. N. Williams. *Oil Gas J.*, 9.11.39, **38** (26), 30.—The McFaddin field of Southern Victoria County, South

Texas, offers an example of systematic development where unusually symmetrical and uniform structural conditions make possible an effective oil recovery.

The field is in a general area once notorious for its treacherous, high-pressure gas sands. Recently, however, the danger of major blow-outs appears to have been controlled.

With only one land ownership involved, it was possible to divide the field into 20-acre units of regular and uniform shape, permitting consistent adherence to the spacing pattern adopted. All wells have been located as near as possible to the centres of the units. Absence of competitive drilling has enabled the operators to drill in the order desired, and to their advantage.

A contour map of the field is given with contour lines on top of the sand. The symmetry of the area as shown by the contours is unusual. A geological section of the field is also given and the geology of the area is discussed. A. H. N.

58.* The Case of Unitization in Re-Cycling. G. Weber. *Oil Gas J.*, 9.11.39, **38** (26), 38.—The fundamental conception which re-cycling is based is conservation: the recovery of condensate otherwise lost under pressure-decline production methods and the saving of gas through its return to the reservoir. Conservation, however, is construed to embrace greater recovery at less cost to the operator, and thus re-cycling on a unitized plan is doubly justified by the principle. This enlarged conception of conservation is found in three main factors in the unitized re-cycling plan, namely: (1) wide spacing of wells; (2) centralized operation; (3) maximum recovery.

In considering well spacing, re-cycling on a field plan allows operators to go far beyond the economy of a 40- or 80-acre spacing pattern. The checkerboard system is unnecessary in such a field plan. In anticlinal fields, where sand uniformity will permit, the gas may be withdrawn from a few wells located on the flank of the structure, and the processed gas input at the top of the structure. This will permit stratification of the lean gas downward and outward through the sand to the flanks of the field, replacing the rich gas withdrawn down structure. Water encroachment may require a variation or reverse of this process, and irregularities in the subsurface structure may demand modifications of the rimming method, but the wide spacing allowed by any plan represents a substantial saving in development costs.

Through centralized operation, unitization in many fields is the only justification for re-cycling. Unlike oil properties which can be developed and produced by many individual operators, the gas condensate production must be re-cycled, if not in a field system, at least in large blocks and with some plan between competitive projects to prevent channelling of the gas from input to production wells.

The maximum recovery of condensate can only be realized by so placing input and production wells that the greatest sweep through the sand will be accomplished. A haphazard arrangement of competitive re-cycling systems in the same sand of a field may serve to pay out the installed equipment, but as operations progress, premature channelizing is certain to occur, cutting yields and trapping rich gas in the reservoir.

The case for unitization is further discussed with relation to equity basis, pressure maintenance, and legal viewpoints. A. H. N.

59.* Thickness of Gas Cap in Yates Field Found by Use of Formula. D. H. Stormont. *Oil Gas J.*, 23.11.39, **38** (28), 48.—The use of Gregory's formula for the calculation of the gas–oil contact is illustrated. The formula is $P_D = P_c + G(D - X) + G_1X$,

where P_D = the pressure at the datum line (1300 ft. above sea-level), lb./sq. in.
P_c = the casing pressure, lb./sq. in.
G = static gas-pressure gradient, lb./sq. in. per ft. of gas column at well-head pressure P_c.
G_1 = static oil-pressure gradient, lb./sq. in./ft. of depth.
D = depth to datum line, 1300 ft., ft.
X = distance between datum and oil–gas contact, ft. A. H. N.

60.* Battery of Oil–Gas Separators Provides Flexible Operation for Test Purposes. Anon. *Petrol. Engr*, Sept. 1939, **10** (13), 56.—A new installation in Saudi Arabia is described. This installation includes equipment to measure all gas produced and to test each of 30 wells individually. A. H. N.

61.* Variable Motor Drive and Movable Derrick Provide Economy. R. M. Pyles. *Petrol. Engr*, Sept. 1939, **10** (13), 93–94.—Continuous pumping at any required speed eliminates shut-down periods due to proration. To achieve this purpose an electric motor with a variable speed—the pumping speed being readily changed by means of turning a handwheel below the motor—has been used.

One derrick mounted on rails serves four wells and helps in economically pumping the crude. A. H. N.

62.* Two Wells Pumped by a Single Beam in East Texas Installation. Anon. *Petrol. Engr*, Sept. 1939, **10** (13), 110.—A case of two neighbouring wells having practically identical weights being pumped by a single beam is cited. The power required in this unusual installation is made a minimum by balancing each of the two wells against the other. A. H. N.

63.* Data on Gas-Driven Pool Disclose Characteristics Differing from Water-Driven Reservoirs. A. M. Crowell. *Petrol. Engr*, Oct. 1939, **11** (1), 25.—In a gas-drive reservoir, as the pressure declines the gas comes out of solution and the oil becomes increasingly inert, until eventually it does not contain enough energy to provide for its own movement to the well-bore. Furthermore, the free gas acts to clog the sand pores, and thus hamper the progress of the oil. The importance of pressure control and maintenance becomes obvious.

This article deals with the early history of the Jones pool and its exploitation to date. The study of this pool is of more than local interest, because of the great care taken in its development and the wealth of data supplied.

The structure of the field is anti-clinal, and the Jones pool is one of the few oil and gas reservoirs from which the natural production is being obtained through volumetric control—and on which comprehensive data have been gathered throughout the productive life. The pool is still in its primary development.

Very accurate information on progressive gas/oil ratio, bottom-hole pressure, and producing rates has been kept both for individual wells and for areally weighted averages for the pool as a whole. Data are also extensive on productivity tests, solubility shrinkage information, bottom-hole sample analyses, etc.

Full production data are presented in the paper, together with pressure contour maps and a proration scheme. A. H. N.

64.* Lightweight Pumping Equipment Saves Small Potential Wells from Abandonment. W. H. Stueve. *Petrol. Engr*, Oct. 1939, **11** (1), 46.—Old and heavy equipment had become uneconomical in the Seminole field, Oklahoma. A large number of wells were to be abandoned unless pumping costs could be reduced.

The solution was found in pumping units powered by 3-h.p. motors, and these extended the life of wells, which are producing now from 3–10 brl./day. A. H. N.

65.* Development and Early Exploitation of a Water Driven Oil Pool under Proration. A. M. Crowell. *Petrol. Engr*, Nov. 1939, **11** (2), 21.—Data on Magnolia field, Arkansas, indicate that water-drive may result in reservoir pressure being maintained at near original figure. Tables and graphs are given for a complete set of data.

The development, early exploitation, and indicated future production policy of this pool are pointed towards the realization of conservation and equity along the lines of sound engineering practice.

Wide spacing, sound drilling equipments, the pooling of tracts into units, and a reasonable practicable manner of allocating production should allow, with the co-operation of the industry, the operation of the pool as a single unit.

Although there is a market for 50,000 brl. of oil daily from the Magnolia field at this time, the proration policy is pledged to an optimum rate, which will be far less. Under the optimum-rate concept it is hoped that no reservoir pressure need be spent other than the flush pressure, and that the greatest practicable recovery from the reservoir may be obtained. A. H. N.

66.* Bottom-Hole Agitation Removes Solution Gas from Fluid in Pumping Wells. H. L. Flood. *Petrol. Engr*, Nov. 1939, **11** (2) 27.—The new device described in the

paper is apparently successful in eliminating gas-lock and in reducing trouble from sanding-up, paraffin deposition, and other difficulties encountered in oil-well pumping.

The apparatus incorporates simple principle and makes use of the slight vibration inherent in tubing string of every pumping well to actuate a series of dashers or agitators, each of which rests on a light coil spring. The resulting agitation in the gas-laden oil simply churns the oil and, assisted by the decreased pressure, hastens the rate at which the gas is liberated. A. H. N.

67.* Application of Displacement Pumping in Peru. J. Henry. *Petrol. Engr*, Nov. 1939, **11** (2), 67.—The author describes a method used to pump a group of wells difficult of access and having low initial production. Twelve small wells located on the steep slopes of a cañon in Peru had to be pumped under the following requirements :—

(1) Control to be sufficiently comprehensive to reduce the input gas–oil ratio to a minimum ;
(2) Unit well control preferable to a central control ;
(3) Equipment to be of sufficiently simple construction to be dealt with by semi-skilled grade of labour ;
(4) Installation cost to be a minimum ;
(5) Sub-surface equipment to be reduced to a minimum ;
(6) Gas input cycles and quantities to be controlled by the surface equipment and quite independently of sub-surface gear.

The solution to this problem is given and diagrams illustrate the method. The description is brief, but the author gives a reference to a comprehensive paper on the subject of displacement pumping which deals with every detail. The paper is by A. Millar, *J. Inst. Petrol. Tech.*, 1932, **18**, 445. A. H. N.

68.* Extensive Gas Conservation Project Underway in Loudon Field. F. B. Taylor, *Oil Wkly*, 5.6.39, **93** (13), 74.—The author describes extensive gas conservation projects under way in the Loudon fields. Excess gas is returned to the strata, which are still at relatively high pressures. The project was designed with the view of future expansion kept in mind. At present five wells are used for gas intake into the formation, injections being effective over 640 acres ; six more wells are to be added shortly to increase the effective injection area. Full details are given of the equipments used and an interesting diagram is furnished for introducing gas into two pay sands simultaneously. A tubing and the casing are used in the well, with the outer pipe perforated against the upper sand, the inner pipe extending to the lower depth, whilst a packer seals the annular space between the inner tubing and the outer casing at a point between the two sands.

Gas hydrate troubles ensued in colder months ; gasoline extraction from the relatively rich gas tended to relieve the trouble, but it was necessary to use alcohol lubrication and ammonia injection before the problem was solved. A. H. N.

69.* Regular Inspections in Pumping Unit Care. J. R. Chambers. *Oil Wkly*, 4.9.39, **94** (13), 19.—Instructions and recommendations are given for the regular inspection of pumping units with a view of maintaining the efficiency and condition of the units at as high a standard as possible. Lubrication duties, the checking of the cooling system, the care of V-belts, and the inspection of air cleaners are typical items in the paper.

Long-period programmes of inspection, as well as weekly and daily routine inspections, are given. A. H. N.

70.* High Rod Stress in Deep Pumping Costly. R. V. James. *Oil Wkly*, 11.9.39, **95** (1), 19–26.—The author believes that high stress is the only important cause of failure, and hence a knowledge of the value of the stress obtained under working conditions is essential to determination of the probable life of a working member. In sucker rods failures have occurred, however, at far lower stresses than the yield stress—the fracture appearance being very different from the ordinary tensile failure. By means of photographs of the cross-sectional views of failures (magnification, × 100),

the author analyses fatigue failures and endurance limits, the effects of grain size, of heat treatment, surface finish, and of the surrounding medium, range of loading, and service conditions on the endurance limits.

A study of rod records shows that comparatively short sections of the rod strings are responsible for a large percentage of the breaks. Such being the case, the discovery of the causes of the critical conditions and the elimination of those causes should greatly increase rod performance. The method of discovering such causes followed by the operator is to study the dynamometer charts; that followed by the manufacturer is to study and improve the material. A. H. N.

71.* **Importance of Gas in Petroleum Production.** C. R. Horn. *Oil Wkly*, 11.9.39, **95** (1), 27.—Gas produced with oil is wasted in enormous quantities. It is estimated that in 1934 alone some 500,000 million cu. ft. of gas were blown to the air and wasted; about sixteen times this quantity was wasted from the beginning of the industry up to 1935. The figures for 1934 mean that approximately one quarter the total gas produced was wasted.

Lack of knowledge of the physical properties and phase relationships of the fluids existing in the oil and gas reservoir has been one of the major handicaps to be overcome by the petroleum industry in its attempt to bring to the surface a greater portion of the oil present in the reservoir rock. The importance of these factors in conservation must not be overlooked.

In this fairly exhaustive paper, the author discusses the forces operating in the production of oil under various conditions, particular attention being paid to the energy of the gas in the reservoir.

The conditions existing in the formations statically are discussed with methods of sampling best suited to study these conditions. Detailed discussion is also given on the two ways in which gas may be liberated from an oil/gas solution: differential and flash liberations; the critical properties of hydrocarbon mixtures with a particular example of 30% methane/70% propane mixture being cited to illustrate retrograde condensation and other interesting points on the phase diagrams; the equilibrium constants and hydrocarbon mixtures; the physical properties of hydrocarbon mixtures, with particular reference to vapour pressure, vapour density, and solubility of gas in oil; the effects of gas in solution on the volume and volume loss on evaporation, the effects on the gravity, the viscosity and surface tension of the crude oil; and finally a study of rates of solution of gas in oil is made.

A bibliography with 61 references is appended. A. H. N.

72.* **Oklahoma City Proves Deep Pumping Practical.** F. B. Taylor. *Oil Wkly*, 18.9.39, **95** (2), 19–22.—Lifting costs have been steadily reduced in the 6500-ft. field of Oklahoma City until 100,000 brl. are being pumped daily, at a minimum cost of 9 cents per barrel. The paper deals with the history of the field from the days when lifting from such depths was considered impracticable, and, if practicable, unprofitable up to the present time.

Practically every conceivable type of lifting device has been tried in this field at some time in its history. In 1936 a survey showed that the following lifting methods were being used in the field: gas lift (136 wells), gas-lift flow devices (124), electrical centrifugal pumps (54), pneumatic pumping heads (11), walking beam (400), hydraulic submerged pump (1).

With pumping problems overcome in economically producing from the Wilcox, operators of the field are investigating the possibilities of applying secondary recovery measures to the formation. It is believed that if such measures succeed an additional 150 million brl. of crude can be lifted from the Wilcox. A. H. N.

73.* **Economic Effects of Recent Oil Discoveries in Illinois.** J. E. Pogue. *Oil Wkly*, 18.9.39, **95** (2), 13–15. Paper presented before National Petroleum Association.—The American petroleum industry has been passing through one of its periodic crises, caused by the discovery and rapid development of new flush oil-fields. The patterns of all such crises are remarkably uniform, since the basic form of the problem is that of absorbing large volumes of crude oil from new sources of supply, necessitating rearrangement of existing trade channels.

The problems which the industry has faced during the past year as a result of recent Illinois discoveries are analysed. The conclusion is reached that uncontrolled production in Illinois, as well as in any other area, is a menace to the stability of the American petroleum industry and to the welfare of thousands of people dependent on it for existence. In Illinois the continuance of present practices will result in greatly reduced recoveries and abnormal costs in later stages. Orderly methods of production must be established. A. H. N.

74.* Properly Conditioned Water Essential to Successful Flooding Operations. C. L. Pate. *Oil Wkly*, 18.9.39, **95** (2), 28.—The operation of flooding is not merely one of injecting water and displacing the oil from the producing horizon. To increase recovery from old oil-fields by water-flooding three elements are necessary : presence of recoverable oil in the reservoir ; an ample supply of suitable or properly treated water ; and power to conduct the various phases of the operations. Far too little attention has been accorded to the second condition, with ultimate loss to the operators.

It is very seldom that water sources free from materials that will plug the formation pores are found, consequently chemical treatment becomes essential.

The author urges the following considerations to be taken before attempting water-flooding : (1) Be certain of ample supply of water. (2) Submit sample to chemist for analysis and recommendation. (3) Design water-treating plant most carefully. (4) Remove oil from salt water obtained from oil wells prior to chemical treatment. (5) Kill algae, diatoms, etc., by an algicide where surface is being treated. (6) Supply plant operator with sufficient chemical equipment for making control tests. (7) Pay special attention to operation of the filter.

The paper deals exhaustively with the chemical treatment of water. The chemical reactions attending the addition of various agents to waters of various salt contents are detailed.

The dry compounded type of reagent which is added to the water as it enters the tank is a complete treatment by itself. When the formulæ is added and mixed with the water, it is supposed to bring about the following results :—

(1) Acts as an oxidizing agent to precipitate iron as ferric hydroxide.
(2) Increases the *p*H value of the water.
(3) Kills or disintegrates live organic matter, such as algæ.
(4) Acts as a coagulant to drag down suspended matter.

The use of aluminium sulphate with muddy waters or waters containing considerable quantities of colloidal material is thoroughly discussed.

The paper ends with a discussion on treating-plant costs and design. The whole discussion is well illustrated in photographs, diagrams, tables, and formulæ.

A. H. N.

75.* Selective Directional Shooting Pays a Profit. F. R. Cozzens. *Oil Wkly*, 2.10.39, **95** (4), 19–20.—In shooting newly drilled wells the area of sand which can be drained into the reservoir thus created depends on the length and type of channel, and if the location be in territory where fluid has no driving force behind it, the operator must consider also the fact that the most effective drainage channels are those which reach upwards and outwards into the body of the sand. The making of such channels, known as angle drainage, is becoming of major importance in re-drilling eastern stripper fields, and some very noteworthy results are being obtained by a system of selective directional shooting.

The method is to drill entirely through the pay sand, and in its very lowest portion make a cavity capable of holding 300–500 lb. of nitroglycerine, gelatin, 90% strength, or its equivalent in straight nitroglycerine. The cavity is made by pop-shotting the lowest 6-ft. portion of the sand-face with 25–50 lb. of dynamite or gelatin. The spoil is removed by suction bailing.

Details of the method and its advantages are given. A. H. N.

76.* Pressure Maintenance Keeps Chalk-Hill Wells Flowing. J. C. Albright. *Oil Wkly*, 2.10.39, **95** (4), 21–23.—The advantages of pressure maintenance practice in the field may be easily seen from the fact that 40% of the wells in this eight-year-old field are still flowing, whereas nearby districts are dependent on pumping.

The pressure plant was designed for injection for residue and purchased dry gas into the sand, and to extract the desired gasoline fractions from the gas taken into the plant from the oil and gas separators at the lease batteries. A description of the plant is given.

As the wells were completed without shooting, the formation was undisturbed and clean holes were the rule. The wells selected for input of the re-pressuring gas were spotted across the property to provide an even distribution of the input gas, to maintain the reservoir pressure, and to move the oil to the producing wells. A. H. N.

77.* Simple Re-Cycling Plant Solves Problems in Distillate Field. B. Mills. *Oil Wkly*, 16.10.39, **95** (6), 18.—The absence of a market outlet for natural gas and the penalties invoked for gas wastage are operating difficulties frequently found in the development of distillate and high gas/oil ratio fields. These conditions applied to the Bammel field, a typical example in Texas Gulf Coast, before a solution was found in a simple efficient re-cycling plant installation.

The present re-cycling effort includes production of the gas under a reduced line pressure from the well, extraction of the distillate with three stages of separation, and return of the dry gas to the formation. The return of the dry gas to the formation meets provisions of the conservation rules, and the market will absorb all distillate produced.

The new plant incorporates several unique operating practices. A remarkable fact about this plant is that it was built entirely by drillers, derrick men and "roughnecks," and without a blue print.

Full details are given of the plant-building and operating conditions. A. H. N.

78.* Efficiency in Pumping. F. B. Taylor. *Oil Wkly*, 16.10.39, **95** (6), 24.—The feel of the experienced pumper often spots and prescribes for trouble promptly. His rôle as a diagnostician of production ailments is important.

In this paper, hints and practices are given about the feel of the pump and pull rods. A. H. N.

79.* Gas Lock and Pumping. H. Huffman. *Oil Wkly*, 23.10.39, **95** (7), 22.—Most wells, after they cease flowing, will continue to produce large quantities of gas for a long period. This gas will come into the well both as free and as dissolved gas. Under these conditions, unless certain precautions are taken and proven principles followed, the efficiency of the pump will be greatly reduced by either complete or partial gas locking.

The gas laws underlying the evolution of gas from solution and the effects of partial or complete vapour or gas locks on the volumetric efficiency of pumps are discussed, and the remedies indicated. The subject is discussed under the two headings "dissolved gas" and "free gas," and a typical example is worked out numerically to illustrate the text.

It has been found that where facilities are not available for disposing of the casing-head gas, lowering this pressure a few pounds by bleeding it off is frequently enough to increase greatly the output of the pump. A. H. N.

80.* Secondary Recovery Projects Harmed but Slightly by Production Shut-ins. F. B. Taylor. *Oil Wkly*, 23.10.39, **95** (7), 28.—The recent Mid-Continent two-week production shut-in apparently had very little detrimental effect on gas re-pressuring or water-flooding operations in most instances.

There were many reasons to anticipate harmful results, largely because of possible trappage of oil and probable loss of pressure through highly permeable streaks.

In isolated cases it appears evident that operations have been injured somewhat seriously, but a majority of the projects have re-established their normal rates of production without difficulty.

In the experience of most of the operators the only previous shut-downs have been very short ones, due to mechanical failures. The review of the results of these extensive shut-downs, however, shows that, on the whole, secondary recovery projects were but slightly harmed. A. H. N.

81.* A.I.M.E. Studies California Economic and Operating Problems. Anon. *Oil Wkly*, 23.10.39, **95** (7), 37.—The possibility of changed economic conditions occurring in the petroleum industry throughout California, particularly in regard to the manner in which oil curtailment is handled, the movement on the part of the Government to acquire certain tideland fields for the exclusive use of the U.S. Navy and to bring about federal control for oil, as well as technical problems and advancements, were studied by the large groups of engineers that attended the two-day session of the Petroleum Division of the A.I.M.E. at Los Angeles.

Abstracts of most of these papers appear in this issue of the *Oil Weekly* under the above headings. Thirteen abstracts appear. A. H. N.

82.* Theft-Proofing Pumping Equipment. Anon. *Oil Wkly*, 30.10.39, **95** (8), 18–20.—Isolated leases, especially when lying in wooded or rolling country, frequently suffer loss of production through pilfrage, such as the stealing of some readily portable and easily removed portion of the pumping equipment which can be junked and sold for a fraction of its replacement value. Since spare parts at lease headquarters or in the Company's tool-house are stocked in proportion to anticipated failure in operation, rather than with regard to portability or pawnability, such petty theft often means the loss of a day's production while replacements are obtained.

The paper illustrates methods and practices followed by various companies to prevent such losses as spark plugs, carburettors, batteries, V-belts, engines, or even complete pumping units—as happened with a particular lease where two units and an engine of a third were stolen. The paper is well illustrated and contains interesting methods. A. H. N.

83.* Much Sand Successfully Separated from Oil. J. C. Albright. *Oil Wkly*, 6.11.39, **95** (9), 32.—Due to the fact that producing formations in the Wilmington field are of an unconsolidated nature and contain only a small amount of calcareous cementing material, sufficient quantities of sand are produced to require each lease, or group of wells, to be provided with an adequate method of sand separation.

In some instances 25% of the total production consists of sand, which is fine enough grained to remain in suspension. The sand also is quite abrasive, cutting flow controls and damaging liners to such an extent that wells must often be reconditioned early in their flowing life, and more or less frequently thereafter.

Methods of separating the sand from the oil include the use of large tanks, where the oil is subjected to a sufficient quiescent zone, to more elaborate equipment, where automatic instruments govern the volume of temperatures and wash-water. Heat exchangers heat the oil and reduce its viscosity so that sand will settle out.

A. H. N.

84.* Pumping Layout Programme Dictates Well Spacing. Anon. *Oil Wkly*, 13.11.39, **95** (10), 88.—The unusual case is cited of drilling four wells to a pattern which was fitted to the type of gear reduction unit selected for purchase and installation when natural flow should fail and mechanical lifting aid be required.

When the wells were drilled in this unusual pattern, the rod-lines tying the odd-numbered wells could be driven in a straight line from one side of the reduction gear, without any part of the drive interfering in any way with the similar type of linkage to the other two wells.

Thus paired, the four wells so nearly balance and approach so closely to the uniform loading of the main shaft of the reduction gear, that none of the usual fluctuation is noted either in the speed or the staccato bark of the exhaust of the four-cylinder gas engine powering the set-up. A. H. N.

85.* Effects of Varying Well Bore Diameters in California Reservoirs. E. K. Parks. *Oil Wkly*, 20.11.39, **95** (11), 24. Paper presented before the American Petroleum Institute.—Present trend towards reduction of well diameter has led to inquiry as to the effects of this practice. The data obtained do not furnish a solution for optimum choice, but are sufficient to indicate that there is doubt whether immediate savings are fully realized. A theoretical discussion accompanies the facts and comments.

with the conclusion that further investigations are warranted. Some of the more important conclusions reached by the author are the following :—

(1) There is a strong economic urge to reduce the size of oil-well casing.

(2) Whatever reduction in potential rate accompanies the smaller size is discounted on the basis of present over-production.

(3) There is a definite conviction by some operators that smaller-sized wells do not result in lower drilling costs.

(4) Differences as to the effect of hole size on drilling cost suggest, that if savings are to be made, there must be consideration of the particular formations encountered and the entire drilling-rig assembly.

(5) A detailed study of this problem is associated intimately with well-completion practice generally.

(6) Whatever effort is expended in providing a solution for the optimum hole size will be a direct contribution to genuine conservation of petroleum, material, and manpower, in that the factors involved are, respectively, cumulative production to an economic limit, steel for wells, and drilling time. A. H. N.

86. Flow of Gas–Liquid Mixtures through Consolidated Sand. H. G. Botset. *Petrol. Tech.*, Nov. 1939, A.I.M.M.E. Tech. Pub. No. 1111, 1–13.—Nichols buff sandstone was used in the experiments after leaching with hydrochloric acid to remove iron oxides and calcareous matter. An accurately cut core with metal piezometer rings was set in pitch. Care was taken to fill all the pores with water, and the eight sections of the core were then found to have permeabilities of 0·457–0·531 darcy along the length of about 4·5 ft. Its porosity was 21·8%.

The experiments show that—

1. The mechanism of approach to equilibrium saturation is very little affected by consolidation of the sand.

2. The equilibrium saturation is probably dependent on cementation and grain-size distribution, but it may easily be determined on a small core sample.

3. The ultimate recovery from a consolidated sand will generally be less than that from an unconsolidated sand of the same permeability, the difference in recovery depending on grain-size distribution and degree of cementation.

4. Assuming a uniform sand with no water drive or structure present, the final saturation at the end of the period of natural production is essentially uniform throughout the sand body.

5. Surface tension and interfacial tension, as well as viscosity, must be relatively unimportant (at least over a moderate range of variation), since the results of experiments on the large core with water and CO_2 agree with those for oil and gas on a small core. G. D. H.

Transport.

87.* Modern Tanker Design. N. J. Pluymert. Paper read before the Society of Naval Architects and Marine Engineers, New York. *Motor Ship*, Dec. 1939, **20**, 308–309.—Constructional and operating data are given for twelve tankers of the Socony Vacuum fleet, of 15,000–16,000 tons deadweight. The principal dimensions of all the tankers are approximately equal. The dates of construction range from 1930 to 1939. Five tankers are steam driven and seven are equipped with diesel machinery.

The amount of welding has increased with each succeeding design. This has resulted in higher deadweight efficiency and, by the elimination of horizontal surfaces and pockets, tends to reduce corrosion. The machinery and cargo-pump weight of the diesel-engined tankers is 450 tons more than the latest-designed turbine drive. It is considered, however, that the saving in fuel consumption of the motor ship offsets the extra machinery weight, when the time between the usual fuelling ports is 30–35 days or more. S. J. A.

Crude Petroleum.

88.* Deodorization of Irak Crude by Means of Soda. H. Pascal. *IIme Congrès Mond. Pétrole*, 1938, **2**, 329–333.—The presence of 1·8% sulphur and 0·11% free hydrogen sulphide in Irak crude introduced difficulties in transporting and refining the crude due to the fumes evolved. These difficulties have now been overcome by the erection of stabilizing plant, but prior to this they were successfully dealt with by injecting a sea-water solution of caustic soda into the crude during pumping operations at the ports of loading. This treatment deodorized the crude, but introduced further difficulties in refining due to (1) persistent emulsions, (2) deposits in pipe stills derived from water-soluble salts, (3) deposits in cracking stills derived from oil-soluble salts. These difficulties were overcome by breaking the emulsions by preheating and washing the crude with fresh water.

A method of estimation of dissolved hydrogen sulphide in crude is given: sweeping the crude with nitrogen and absorbing hydrogen sulphide in zinc or sodium acetate. W. P.

89.* Petroleum Emulsions and their Chemical Resolution. L. T. Monson. *IIme Congrès Mond. Pétrole*, 1938, **2**, 335–343.—A survey of the theory and practice of de-emulsification of crude oil. The author discusses various general theories of emulsification in the light of his experience with crude-oil emulsions. Recent developments in the practice of de-emulsification are indicated, plant described, and methods of testing discussed. W. P.

Cracking.

90.* Combination Selective Cracking. E. R. Smoley, W. Meckler, and A. H. Schutte. *IIme Congrès Mond. Pétrole*, 1938, **2**, 355–368.—Selection of stocks according to boiling range and according to refractivity (which differentiates virgin from re-cycled stocks) leads to higher efficiency in cracking processes.

Flow-sheets and plant data are given in detail for a number of modern three- and four-coil combination cracking units. The arrangement of equipment is discussed and a new type of heater described, whereby the heating curve is controlled by the use of independently fired heating and soaking sections. W. P.

91.* Selective Cracking and Continuous Coking. J. Grant. *IIme Congrès Mond. Pétrole*, 1938, **2**, 369–374.—An account of a reconstruction programme undertaken by Shell Petroleum Corporation at Wood River, whereby the Dubbs fuel-oil cracking plant was modernized by installation of selective cracking and continuous coking equipment. The operation of the new unit is described. The advantages of the new unit are: (1) reduced operating cost, (2) increased "on stream" efficiency, (3) ability to vary production of gasoline and intermediate distillates at will, (4) production of gasolines of 70–72 octane number. W. P.

Hydrogenation.

92.* Hydrogenation of Hydrocarbons in Absence of Catalysts. A. Leopold. *IIme Congrès Mond. Pétrole*, 1937, **2**, 217–222.—Hydrogenation in absence of catalysts is discussed and the results of three series of experiments under different conditions are given in detail. It is concluded that the yield of light products obtained by hydrogenation depends not only on the temperature, pressure, and duration, but also on the relative proportions of hydrogen and hydrocarbons. W. P.

93.* Industrial Production of Gasoline by Selective Hydrogenation in Absence of Catalysts. A. Leopold. *IIme Congrès Mond. Pétrole*, 1937, **2**, 223–225.—Continuing work already published (see preceding abstract), it is shown that the nature and quantity of products produced by hydrogenation depend on six main factors: pressure; temperature; duration; speed of circulation; the steel surfaces of the apparatus;

and the volume of the material processed. The hydrogen consumption depends on the type of hydrocarbon processed and on the method of splitting involved. The reaction can be exothermic or endothermic, according to the relative amounts of hydrogen and hydrocarbons present, and this ratio must be suitably adjusted to achieve economic yields. A modified form of pipe-still has been found more effective and cheaper than autoclaves for carrying out hydrogenation. W. P.

94.* Hydrogenation of Roumanian Petroleum. C. Candea and A. Marschall. *IIme Congrès Mond. Pétrole*, 1937, **2**, 227–236.—A study of the hydrogenation of crude oil and of its various fractions using molybdenum sulphide as catalyst. It is concluded that the process depends not only on temperature, pressure, and duration, but also on the chemical composition of the basic material. In the process used, optimum temperature of 300–350° C. and optimum pressure of 200–300 atm. gave yields up to 50% of gasoline. The gasoline has a reduced percentage of unsaturated hydrocarbons and an increased precentage of aromatics and naphthenes. Its sulphur content is low, and it has a low tendency to gum formation. W. P.

95.* Catalytic Hydrogenation of Low-Temperature Tar under High Pressure. S. Ando. *IIme Congrès Mond. Pétrole*, 1937, **2**, 237–248.—Low-temperature tar produced from Hokoku coal by the Imperial Fuel Research Institute of Japan was hydrogenated under varying conditions employing a 5-litre revolving autoclave. High pressures and molybdenum catalysts were used. The effects of temperature, time, pressure, and tar–hydrogen ratio were studied in relation to yield and quality of products. Full data are given relating to about thirty tests. In general, higher temperatures gave greater yields of fractions below 200° C. with higher aromatic content; higher pressures gave greater yields of fractions below 200° C., but slightly lower aromatic contents. Increased time of reaction gave lower yields and higher hydrogen consumption. W. P.

96.* Hydrogen of Tars and Tar Oils. J. G. King and C. M. Cawley. *IIme Congrès Mond. Pétrole*, 1937, **2**, 249–262.—With a view to utilizing tars produced by low-temperature carbonization, hydrogenation of tars and tar distillates has been studied at the Fuel Research Station, England. The reactions involved and the effects of the various variants are discussed and experimental data presented. The effective production of gasoline from tar requires a two-stage hydrogenation: liquid-phase followed by vapour-phase. Molybdenum catalysts are used, those deposited on alumina being found superior to the pelleted form. Low-temperature tars process better than high-temperature tars; of the latter, vertical retort tars are better than horizontal retort tars. Higher temperatures accelerate hydrogenation, but decrease maximum degree of reaction. The effect of pressure is complex, but in general high pressure improves the yield and there is less deterioration of catalyst. Laboratory and semi-technical plants are described. W. P.

97.* Massive Catalysts in High-Pressure Hydrogenation. M. Pier. *IIme Congrès Mond. Pétrole*, 1937, **2**, 263–270.—The use of solid catalyst in massive form is claimed to be superior to their use in a finely divided form. The latter form is limited to liquid-phase reaction and is especially convenient where fresh catalyst must be continuously added. The former method, however, is adapted to both vapour- and liquid-phase reactions.

The influence of temperature, pressure, and type of catalyst is demonstrated in the production of gasoline from coal-tar oils.

The hydrogenation of lubricating oils to improve their viscosity–temperature susceptibility is described. W. P.

98.* Hydrogenation of Cracked Gasoline. K. Kudo and H. Fujimoto. *IIme Congrès Mond. Pétrole*, 1937, **2**, 271–275.—Cracked gasolines are not satisfactory as aviation fuels owing to their chemical instability, but suitable fuels can be prepared from them by hydrogenation. Laboratory and semi-technical experiments are described in which cracked gasoline was hydrogenated in the presence of nickel oxide as catalyst. W. P.

99.* Hydrogenation of Residues (Especially Cracked Residues). J. C. Vlugter. *IIme Congrès Mond. Pétrole*, 1937, **2**, 277–280.—Two or multiple stage processes are advocated for the catalytic hydrogenation of petroleum residues: a liquid-phase stage followed by vapour-phase stages. Semi-technical plant is described in which Irak residues were first hydrogenated in the liquid-phase to yield mainly gas oil, which was then hydrogenated in the vapour-phase to yield high-quality gasoline. W. P.

100.* Production of Aviation Gasoline by High-Pressure Hydrogenation. C. L. Brown and E. J. Gohr. *IIme Congrès Mond. Pétrole*, 1937, **2**, 281–287.—The demand for aviation gasoline of high octane number, volatility, and stability is best met by hydrogenation of petroleum fractions. Three types of process are available :—

(1) Moderate temperature hydrogenation with newly designed catalysts giving high conversion and selective dehydrogenation of cyclic compounds. This process yields gasolines of high volatility, no olefines, low sulphur, stability, and high lead susceptibility, such as are required in the preparation of 100 octane Army fuels.

(2) High-temperature hydrogenation with conventional catalysts yields highly aromatic gasolines. This process gives lower yields but higher octane numbers, albeit less susceptible to lead.

(3) Low-temperature hydrogenation of branched olefine polymers such as di*iso*butylene.

Details of the products produced by processes (1) and (2) are given. Process (3) is discussed in a separate paper (*vide infra*). W. P.

101.* Hydrogenation of Olefine Polymers for Manufacture of High-Octane-Number Fuels. C. L. Brown and E. J. Gohr. *IIme Congrès Mond. Pétrole*, 1937, **2**, 289–298.—The third method of production of high-grade aviation gasolines mentioned in the preceding abstract is discussed—*i.e.*, the hydrogenation of *iso*butylene polymers and co-polymers. The properties of blends of hydrogenated products and natural gasolines are listed, as well as those of commercial di- and tri-*iso*butylene, co-polymers, and mixed polymers. The flow diagram of a commercial plant at Baton Rouge is given and parallel laboratory experimental work described.

The lead susceptibility of the hydrogenated fuels is discussed. W. P.

102.* Germany's Coal-Oil Supplies. Anon. *Petroleum Press Service*, 17.xi.39, **6**, 44, 529–532.—It is considered that only a portion of Germany's programme for the coal-oil industry has been completed. Many plants were due to come into operation in 1940, whilst some were only scheduled for completion in 1941. There is an extreme paucity of official information on the subject, but it is possible to piece together from various sources an outline of the industry. The various plants known to be operating or in the course of erection are as follows :—

Company.	Estimated Capacity. Tons of motor spirit per annum.
Hydrogenation of Lignite and Coal.	
I.G. Farbenindustrie (Leuna)	350,000
Braunkohlen-Benzin A.G. (4 plants)	500,000
Union Rheinische Braunkohlen-Kraftstoff	150,000
Hydrierwerk Scholven A.G.	150,000
Gelsenberg-Benzin A.G.	300,000
Hydrierwerk Politz (Stettin)	—
Synthetic Processes (Fischer-Tropsch).	
Wintershall A.G. (3 plants)	150,000
Ruhrbenzin A.G.	30,000
Krupp-Treibstoffwerk G.m.b.h.	—
Hoesch-Benzin G.m.b.h.	—
Castellengo-Abwehr Kohleverdelung	—
Graflich Schaffgott'sche Benzin (Deschowitz)	—
Brux (Sudetenland)	Planned for 600,000 tons.
Gutehoffnungshutte	75,000
Extraction Processes (Pott-Broche).	
Ruhrol G.m.b.h.	(Extract hydrogenated.)

It is considered possible that production of light motor fuels will reach 1,800,000 tons in 1939, calling for about 8 million tons of lignite. In the construction of these large units of coal-oil production considerable quantities of special steels are required, which may not be readily available to Germany under war conditions. The possibilities of production of diesel oils and high-octane fuels from coal-oils are considered doubtful. S. J. A.

102*a*.* **Production of Aviation Fuels by High-Pressure Hydrogenation.** E. V. Murphree, E. J. Gohr, and C. L. Brown. *Industr. Engng Chem.*, 1939, **31**, (9), 1083–1089.—The application of high-pressure hydrogenation to the production of aviation gasolines, blending agents, and 100 octane fuels is discussed. The hydrogen necessary for these various processes is produced in a two-stage operation as follows. In the first stage a mixture of steam and natural gas is passed through a bank of parallel tubes containing catalyst heated to a high temperature. Hydrogen and carbon monoxide are formed in this stage. Additional steam is then added to the mixture, and further reduction is conducted in a second stage at a lower temperature. In this second stage the carbon monoxide and steam react to produce carbon dioxide and more hydrogen.

A typical aviation naphtha hydrogenation plant at conversions of 50–75% per pass yields 80–95% of 75–78 octane hydrogenated naphtha having excellent stability, high lead susceptibility, low sulphur content, and good colour.

Hydrogenation of *iso*butylene dimer and *iso*-normal butylene codimer increases the octane number from 82–84 to 97–100, but this material, on account of its volatility, is only suitable as a blending agent. Various tables are given showing the characteristics of the hydrogenated fuels and polymers, and various high-octane aviation fuels produced by blending hydrogenated products. H. E. T.

Polymerization.

103.* **Polymerization and Alkylation of *iso*Butylene for Production of *iso*-Octane Fuels.** G. Natta and M. Baccaredda, *Chim. e Industria*, 1939, **7**, 393–418.—The continuously increasing importance of processes for polymerization of olefines for production of high-octane gasoline is pointed out, and the necessity of a more careful segregation of cracking and refinery gases is stressed.

In Italy, in particular, where the processing of petroleum products is limited, a separation of the various components of the gaseous blends from cracking should be effected, using, for instance, *iso*butylene and *iso*butane for the synthesis of 100 O.N. fuels, propylene for the production of *iso*propyl alcohol, butadiene together with ethylene for synthetic rubber.

The various chemical procedures proposed for the polymerization and alkylation of olefines are then examined and classified according to the catalyst employed, sulphuric acid, phosphor and arsenic acids, halogenated metals and gaseous catalysts.

A method studied by the authors for the production of *iso*-octane through dimerization of *iso*butylene is described: the method is an eminently selective polymerization, which is effected in presence of two catalysts, gaseous (HCl) and solid (aluminium oxide in most cases). The influence of the various factors, such as temperature, contact time, and concentration of the catalyst, is discussed. It was found that by operating at 200° C. with 1% of HCl and contact times of a few seconds it was possible to obtain yields higher than 80% of transformed *iso*butylene. During this process is formed a small amount of *iso*butyl chloride, which can be easily eliminated by fractionated distillation and then re-cycled as catalyst, though less active than HCl. It was noted that the polymerization leads also to the formation of tri*iso*butylene, transformable by means of appropriate catalysts, almost quantitively to di*iso*- and *iso*-butylene.

It is pointed out that the solid catalyst, aluminium oxide, can easily be regenerated, and that the selective polymerization with hydrochloric acid has the advantage of operation at relatively low temperatures, normal pressure, and in presence of other hydrocarbons. P. G.

Synthetic Products.

104.* Fischer–Tropsch Synthesis of Hydrocarbons and Some Related Reactions. S. R. Craxford. *Brennst Chemie*, July 15, 1939, **20** (14), 263–270.—At the temperature of the Fischer synthesis carbon monoxide reacts slowly with the Fischer catalyst, forming cobalt carbide as follows: $2Co + 2CO \longrightarrow Co_2C + CO_2$. This reaction is always slower than the hydrogenation of the carbide by hydrogen at the same temperature. The catalyst reacts at this temperature with carbon monoxide and hydrogen under carbide formation as follows: $2Co + CO + H_2 \longrightarrow Co_2C + H_2O$. This reaction is more rapid than the hydrogenation of the carbide by hydrogen under similar conditions.

Hydrogenation of Co_2C may lead to formation of methane or higher hydrocarbons. Tests have shown that, in the Fischer synthesis, the *ortho-para*-hydrogen transformation is inhibited if oils are produced. This proves that very little adsorbed hydrogen is present at the catalyst surface.

Among the variety of conditions under which methane is formed in place of oil, the *ortho-para*-hydrogen conversion proceeds without difficulty, which shows that in this case adsorbed hydrogen is present.

The water-gas balance reaction proceeds parallel with the *ortho-para*-hydrogen transformation. It starts when methane is formed, and is inhibited during the oil formation of the Fischer synthesis.

The destructive hydrogenation of paraffin hydrocarbons on the Fischer catalyst is inhibited during the Fischer synthesis in a similar way as in the presence of carbide at the catalyst surface. Otherwise it occurs easily at the temperatures encountered.

If ethylene is added to the process gas, it is absorbed by the products, but at the same time causes formation of oxygen-containing organic compounds such as alcohols, acids, etc.

Theoretical conclusions are summarized as follows: the initial stage of the Fischer synthesis is an alternate formation and hydrogenation of cobalt carbide, by which methylene groups are obtained. In the presence of adsorbed hydrogen, the latter are further hydrogenated to methane. If conditions are more in favour of the formation than the reduction of carbide, very little chemically adsorbed hydrogen exists at the surface, and CH_2 groups combine to form long chains. The resulting products are broken from the long chains at the surface by the attack of the adsorbed hydrogen. If the carbon monoxide is adsorbed in the outer adsorption layers and does not come into contact with the catalyst surface, oxygen compounds are likely to be formed.

L. R.

105. Importance of the Fischer–Tropsch Process for German Production of Diesel Oils. H. Koelbel. *Brennstofftechnik.*, 1939, **20**, 352, 365.—A high percentage of the oils yielded by the Fischer–Tropsch process is Kogasin II, a diesel fuel with ideal boiling range and a cetene number of 105, compared with 65 for the best natural diesel oils. Analysis of the fuel shows it to have a high hydrogen content and to contain no impurities like sulphur or coke. Engine tests gave good results provided the compression ratio of the engine was lowered to about 12 : 1. A serious drawback of this synthetic fuel, apart from the high cost, is the fact that it solidifies at about 2° C. The author found, however, that a mixture of Kogasin II with a tar oil resulted in a product with pour point -20° C. Tests in ordinary commercial diesel engines with this mixture showed a low consumption and high output of the engines. It is hoped that the new fuel will make Germany more independent of foreign fuels, as even in 1938 90% of the diesel fuels had to be imported.

E. W. S.

106.* Synthesis of Gasoline and Oils from Water Gas. F. Martin. *IIme Congrès Mond. Pétrole*, 1937, **2**, 299–307.—The historical development of the Fischer–Tropsch process is briefly mentioned and the commercial development from 1933 to 1937 described in more detail. The large-scale industrial plant operated by the Ruhrchemie A.G. is illustrated in numerous photographs, and the properties of the products and heat flow data are given. The development has depended on five major factors;

1. Increase in the life of the catalysts employed.
2. Cheap large-scale contact chambers and sulphur eliminators.
3. Recovery of rare metals and oxides from spent catalyst.

4. Working up the primary product, Kogasin, to improve its anti-knock value.
5. Production of cheap water gas from available materials—*e.g.*, brown coal, peat, coke, etc.

Future possibilities of chemical synthesis by this process are suggested. W. P.

107.* Formation of Methane from CO–H_2 Mixtures Using Low-temperature Coke and High Pressures. H. Brueckner. *BrennstChemie*, 1939, **20**, 346–348.—In the reaction of solid fuels with an oxygen–hydrogen mixture, methane is formed in a secondary reaction of the carbon monoxide–hydrogen mixture with the low-temperature coke contained in the producer. According to the result of the tests made at 500–700° C. and up to 1150 lb./sq. in., the synthesis of methane takes place essentially according to the equation: $2CO + 2H_2 = CH_4 + CO_2$. A formation of methane from CO according to $CO + 3H_2 = CH_4$ could not be stated. The methane output rises with temperature, the maximum yields with 40% methane content in the reaction gas being reached with 560 lb./sq. in. and 700° C. E. W. S.

Refining and Refinery Plant.

108.* Electrical Process for Extraction of Salts from Refinery Charging Stock. T. N. St. Hill and H. C. Eddy. *IIme Congrès Mond. Pétrole*, 1938, **2**, 345–350.—The presence of salts in crude oil gives rise to deposits in still-tubes, increased coke formation, and severe corrosion, particularly if hydrogen sulphide is also present. The electrical system of salt removal is claimed to be superior to any washing system. A certain amount of water is added to the crude, which is then circulated between electrodes carrying high potential. Separation takes place without resort to settlement tanks, and although the resulting oil still contains water, the salt content is much reduced. Apparatus is described and costs are analysed. W. P.

109.* Catalytic Purification of Gas Oils. E. Lege. *IIme Congrès mond. Pétrole*, 1938, **2**, 351–354.—Gas oils can be refined by treating them under controlled conditions with sulphuric acid at temperatures from 150° to 250° C. The process is equivalent to a low-temperature cracking process and yields stable oils of naphthenic structure. W. P.

110.* Knowles Coking Process. C. W. Andrews. *IIme Congrès mond. Pétrole*, 1938, **2**, 375–378.—A description of a Knowles Coking Plant at East St. Louis to convert ordinary grades of fuel oil into grades suitable for domestic heating purposes, together with gasoline, gas, and coke. Analyses of the products are given. W. P.

111.* Lachman Process for Refining Cracked Gasoline by means of Zinc Chloride in Vapour Phase. M. Reymonenq. *IIme Congrès mond. Pétrole*, 1938, **2**, 379–388.—The Lachman process as commercially operated in California and in Europe utilizes the catalytic effect of zinc chloride solutions in contact with the vapour phase. Di-olefines are polymerized, but olefines and aromatics left unchanged to produce high-grade gasoline of good colour and gum stability. The commercial apparatus and its operation are described and analyses of the products given. W. P.

112.* Clay Treatment of Cracked Gasoline in Liquid Phase. Ancap Refinery. *IIme Congrès mond. Pétrole*, 1938, **2**, 389–393.—A description of plant erected in Uruguay for the distillation, cracking, and subsequent treatment of petroleum fractions. A Dubbs cracking plant is linked with a unit in which the gasoline is treated with clay before re-distillation. This treatment removes gums and gum-forming bodies to yield a gasoline of good gum and colour stability. Ordinary clay is broken down, dried, and screened for use in the plant. W. P.

113.* Use of Copper Salts in the Refining of Kerosine. M. H. Roche. *IIme Congrès mond. Pétrole*, 1938, **2**, 395–398.—Sweetening kerosines by the Doctor Treatment is

not always satisfactory and the use of copper chloride is suggested. A process has been developed in which the normal decolourising earth is supplemented by earth previously treated with copper sulphate and sodium chloride. The process is equally applicable to other petroleum fractions. W. P.

114.* Sweetening Gasolines with Copper Salts. W. L. Benedict, C. G. Dryer, J. C. Morrell, and G. Egloff. *IIme Congrès mond. Pétrol*, 1938, **2**, 399–406.—The use of copper salts in sweetening gasoline is claimed to obviate entirely the known disadvantages of the customary Doctor Treatment. Laboratory and commercial equipment are described for carrying out a process using solid cupric sulphate and ammonium chloride carried by fuller's earth. Intermediate setting is avoided and the process is continuous, yielding a gasoline superior to that obtained by plumbite sweetening. W. P.

115.* Improved PbS Sweetening Process. C. W. Stratford and D. B. Nutt. *IIme Congrès mond. Pétrole*, 1938, **2**, 407–411.—The disadvantages of the Doctor Treatment are overcome by a process using a suspension of preformed lead sulphide in concentrated caustic soda, the solution being kept continuously in chemical equilibrium by addition of sodium sulphide. This process, the Stracto process, has been in successful operation for several years, and examples are given of its working. W. P.

116.* Cold Acid Treatment of Cracked Gasoline. C. W. Stratford, F. G. Graves, and E. S. Brown. *IIme Congrès mond. Pétrole*, 413–419.—In the cold acid treatment of cracked gasoline it is essential to have (*a*) controlled temperature, (*b*) optimum dispersion of acid, (*c*) controlled contact time. There is always a maximum temperature above which the process is less economical; this temperature lies between 20° and 60° F. In the absence of control, acid consumption is excessive, treating and polymerization losses are high, and there is a decrease in octane number of the products. A recent commercial installation for cold acid refining—the Stratcold Plant—is described. W. P.

117.* Deasphalting and Acid Treating in Propane Solution for Production of Bright Stocks and Cylinder Stocks. W. H. Bahlke, E. W. Thiele, C. E. Adams, and B. Ginsberg. *IIme Congrès mond. Pétrole*, 1938, **2**, 421–433.—An account of experimental investigations on the deasphalting and acid treating of Mid-Continent residuum preparatory to the erection of commercial plant at Whiting, Indiana. The plant is described. Residuum and propane are mixed at 100° F. in the ratio of 1 to 3 by volume and settled in a horizontal drum. The lighter layer is acid treated in vertical drums in a two-stage counter-current operation. After neutralization with weak caustic solution and settlement, propane is distilled and recovered and asphalt is removed by fluxing with light oil. W. P.

118.* Sulphuric Acid from Refinery Gases. F. L. Claise and E. S. Brown. *IIme Congrès mond. Pétrole*, 1938, **2**, 441–446.—The proximity of the El Segundo refinery to a sulphuric-acid plant working the contact process has enabled the refinery to convert a potential nuisance into an economic proposition. The hydrogen sulphide produced in the cracking of South Californian Crudes is removed from the cracked gases by washing with sodium phenolate. The hydrogen sulphide is recovered, purified, and burnt under controlled conditions to yield sulphur dioxide and oxygen in suitable proportions for catalytic conversion into sulphur trioxide. The hydrogen-sulphide recovery plant is described in detail. W. P.

119.* Recent Progress in Refinery Acid Recovery. S. F. Spangler. *IIme Congrès mond. Pétrole*, 1938, **2**, 447–449.—A description of the Chemico Sludge Conversion Process, in which acid sludge is decomposed by heating; the sulphur dioxide so produced is purified and catalytically transformed to sulphur trioxide. Thermal decomposition is effected by utilizing the excess coke produced in the reaction as a heat-carrier. Purification entails condensation of water and hydrocarbons by scrubbing, oxidation of non-condensable hydrocarbons by heating in a secondary furnace, cooling by scrubbing, and removal of acid mist by Cottrell precipitation. W. P.

120.* **Absorption Process of Natural Gasoline Extraction.** R. W. Machen. *Petrol. Engr*, Sept. 1939, **10** (13), 47.—The major portion of natural gasoline is still extracted by the absorption process. An absorption plant consists of three distinct processing units for absorption, distillation, and stabilization, respectively. In older plants absorption columns of the " filled type " are still used. Whilst the initial cost is low, this type of absorber is characterized by a tendency of the oil and gas to channel and a low throughput capacity. The plate tower is more efficient, the simplest form of tray being a perforated plate. A disadvantage of this type is that a fixed gas velocity must be maintained or the oil will fall through the perforations rather than through the overflow pipes. This objection is largely eliminated by fitting a loose rivet into the holes. This rivet rises and falls with increasing and decreasing gas velocity. The " bubble-cap " plate has been developed to overcome the disadvantages of other plate columns. Caps are fitted on to gas chimneys fitted into the plates. The gas passes through the slots in the flange of the cap and bubbles through the oil on the tray.

The absorption oil used is determined by the still, and, generally speaking, a heavy oil, distillation range 475–600° F., is used in old-type steam-still, whilst more efficient modern stills used a narrow kerosine fraction, distillation range 375–500/525° F. Control of the temperature of the absorption oil is an important feature of efficient extraction. In some plants the oil, after dropping through a few plates, is passed through a propane–butane chiller before passing on to the next lower plate. The sludge and residue content of an oil influences the circulation required for efficient extraction, and some plants are provided with a special unit to continuously strip the oil of sludge and residue. R. J. E.

121.* **Solvent Refining of Petroleum.** B. Kwal. *Petrol. Engr*, Sept. 1939, **10** (13), 66.—Solvent extraction has provided a means of manufacturing a high-viscosity-index lubricating oil from mixed base and naphthenic base stocks. The solvent may either dissolve the high- or the low-viscosity-index components of the base, but good selectivity is an essential feature for economic use. Simple equipment for the process consists of a battery of vertical columns in which the base and the solvent flow counter-currently. The first process was developed by Edeleanu using SO_2 as solvent for the aromatic and unsaturated hydrocarbons. An increase of the solvent power of SO_2 is effected by the addition of benzol. Other solvents used in a similar manner are phenol, nitrobenzene, furfural, and chlorex. Aromatic amines have also been shown to give effective results. Flow diagrams for phenol and chlorex extraction processes are shown and a detailed account of a furfural plant is given. Advantages of using furfural are low cost of solvent and the efficient removal of naphthenic acids, so that further treatment with caustic soda is unnecessary.

Propane differs from the solvents, in that it dissolves the raffinate and precipitates the asphaltic matter and resins of the base material. In the Duo-Sol process both types of solvent are used. Propane dissolves the raffinate, and phenol or cresol dissolves the naphthenic acids and naphthenic hydrocarbons. A feature of this process is excellent selectivity. R. J. E.

122.* **Turbidity of Selective Solvent Treated Oils.** L. A. Gukhman, I. M. Orudjeva and G. B. Gurvich. *Azerb. neft. Khoz.*, Feb. 1939, **19** (2), 37–39.—Selective solvent-treated oils from Bibi-Eybat and Balakhany crudes, and also Surakhany bright stock, have been found to become turbid during storage owing to the precipitation of solid, apparently naphthenic, hydrocarbons. This turbidity appeared in all cases at comparatively high temperatures—say 10–15° C.—in spite of sufficiently low pour points (below 0° C.). Beginning from the temperature of commencing turbidity, a further fall in temperature caused a rapid increase of viscosity, much in excess of that of non-clouding oils of the same viscosity index.

The only means of safeguarding an oil against clouding was found to be dewaxing. Neither filtration at the clouding temperature nor addition of paraflow was successful. Paraflow addition, however, though not preventing turbidity, considerably improved the viscosity curves of clouded oils, so that they approached those of the dewaxed oils.

It is recommended to examine by means of practical engine tests to what extent the turbidity of the oils affects their performance. L. R.

123.* Production of High-Grade Lubricating Oils from Dossor-Makat Crude by Shapiro Dewaxing Method. G. L. Shapiro and L. G. Zakharenko. *Neft Khoz.*, July 1939, **20** (7), 34–39.—Dossor-Makat crudes are of very distinct paraffinic nature, and their wax content, although very small, tends to separate and to cause trouble at low temperatures, so that it has to be removed. The method, developed by G. L. Shapiro, of simultaneous refining and dewaxing by sulphuric acid application at low temperatures has been investigated. As raw material Dossor-Makat Permo-Trias semi-goudron was used. Compared with the usual pour point of −10° to −12° C., an oil with a pour point between −28° and −30° C. was obtained. A pour point of −28° C. resulted when treating at −40° C., whilst for a pour point between −23° and −24° C. treatment between −30° and −32° C. was sufficient.

In the latter case optimum treating conditions were: consumption of H_2SO_4, 10% of concentrate; consumption of diluents (naphtha and ligroine), 100–120% of concentrate. The resulting oil had a specific gravity of 0·896, a viscosity of 2·95–3·05° E. at 100° C., a viscosity index of about 85, zero Sligh test, and 0·8–0·9% Conradson carbon. A colour of 7½-8 N.P.A. was obtained with about 5% clay.

Oil yield is increased by means of the Shapiro method above the conventional by 63–72%, with 40% less acid and 75% less clay consumption. By combined Shapiro refining and dewaxing with additional selective solvent treatment, the sulphuric acid consumption can be reduced from 10 to 6% if naphthenic acids are used to improve goudron settling.

Refining-dewaxing with 6% acid and subsequent treatment with 350% nitrobenzene produce an oil with 95 viscosity index, 0·4% Conradson carbon, with a yield of about 68% of the dewaxed oil, or 52% of the goudron raw material. Selective solvent treatment with the same quantity of furfurol results in an oil with 94 viscosity index, and 0·6% Conradson carbon, with a yield of 80% of the dewaxed oil or 61% of the original semi-goudron.

During the selective treatment the acid number of the oil, which had been increased by the addition of naphthenic acids, falls to 0·01 SO_3, whilst the pour point rises 5–6° C. L. R.

124.* New Government Refinery at Luján de Cuyo. Anon. *Bol. Inform. Petroleras*, Sept. 1939, XVI (181), 111–122.—Article describing the opening ceremony and technical particulars of a new refinery at Luján de Cuyo in Mendoza, the plant erected being capable of producing annually 90 million litres of petrol of high octane number, 5 million litres of kerosine, 8 million litres of gas oil and about 45,000 m.³ of fuel oil. Provision is made for handling 14,000 m.³ of crude oil per month. H. I. L.

125*. Filter Rates of Clay–Oil Slurries. H. H. Bible, M. A. Witte, and J. W. Donnell. *Industr. Engng Chem.*, 1939, **31**, 1007.—Poiseuille's Law has generally been considered to represent the rate of flow through the filter-cloth and cake, but it is shown by these authors that the flow through the cloth is turbulent, and that in the experiments performed the cloth represented 8–40% of the total pressure fall. It is therefore recommended that in filtration problems the cloth resistance be allowed for independantly of the cake resistance.

The data obtained on the oil–clay slurry used have been correlated with respect to the effect of pressure on the filtration rate at constant viscosity, and the effect of viscosity on the filtration rate at constant pressure. J. W. H.

126.* Packing the Centrifugal Pump. F. C. Thorn. *Industr. Engng Chem.*, 1939, **31**, 929.—The principles of the design of stuffing-boxes for centrifugal pumps working under various conditions are discussed, and the conclusion is reached that leaking of the fluid being pumped may be reduced to a negligible amount by attention to gland design and selection of the correct type of packing. Gland leakages may even be reduced to zero by the application of liquid seal glands.

The structure, composition, and use of rubber fabric, braided, plastic, and metal foil packings is discussed. J. W. H.

127.* Action of Filter Aids. P. C. Carman. *Industr. Engng Chem.*, 1939, **31**, 1047.—The addition of a kieselguhr filter aid to a rigid cake composed of quartz particles,

comparable in size to the kieselguhr particles, is shown to increase the permeability of the cake. This increase in permeability is shown to be quantitatively related to the porosity of the cake by means of the direct determinations of the permeability and porosity.

The relationship between percentage filter aid and cake resistance for a non-compressible cake is similar to that obtained for a compressible cake. This substantiates the theory that the main action of a filter aid is to increase the porosity of the cake.

J. W. H.

128.* **Separation Processes. Fractionation of Partially Miscible Liquids.** M. Randall and B. Longtin. *Industr. Engng Chem.*, 1939, **31** (9), 1181.—The calculation of the number of plates in the fractionation of partly miscible liquids of the minimum boiling point and eutectic vaporization types is discussed. The arrangement of columns necessary to carry out such a fractionation is considered. P. D.

129.* **Extraction in Spray and Packed Columns.** T. K. Sherwood, J. E. Evans, and J. V. A. Longcor. *Industr. Engng Chem.*, 1939, **31** (9), 1144.—Data were obtained on the extraction of acetic acid dissolved in water by benzene and by methyl *iso*butyl ketone. In the first set of experiments extraction was carried out in an unpacked tube using drops the dimensions of which were measured. In the second set various heights of packing were used. The packing consisted of ½-in. and 1-in. carbon rings, and ½-in. birl saddles. The tower was also operated as a spray tower.

The results indicate that Ka, the product of the extraction coefficient and the interfacial area, depends primarily on a. Ka increases roughly in proportion to the rate of the disperse phase. As the rate of the continuous phase is increased, Ka first rises sharply and then falls, due to coalescence. The drop size depends on the packing rather than on the initial size of the drops fed to the column. P. D.

130.* **Counter-current Absorption.** H. B. Osborn and C. W. Simmons. *Industr. Engng Chem.*, 1939, **31** (9), 1105.—A large-scale testing unit was constructed with an absorption tower 10 ft. by 1 ft. i.d., packed with 1-in. rings. Experiments were carried out on the absorption of CCl_4 vapour from air by kerosine at approximately room temperature. P. D.

131.* **Mass Transfer between Phases: Rôle of Eddy Diffusion.** T. K. Sherwood and B. B. Woertz. *Industr. Engng Chem.*, 1939, **31** (8), 1034.—The relative importance of eddy diffusion and film diffusion was investigated experimentally by measuring the water–vapour gradient in a turbulent stream of gas, flowing in a square duct, one side of which was covered with a film of water, whilst the opposite wall was covered with a strong $CaCl_2$ solution.

Air, carbon dioxide, and helium were used. It was found that each film offered 21–36% of the overall diffusional resistance. The Reynolds number was varied from 3600 to 102,000. The product of the diffusional resistance and the gas density was found to vary with Re in the same manner for all three gases. P. D.

132.* **Absorption of Gases by Liquid Droplets.** H. F. Johnstone and G. C. Williams. *Industr. Engng Chem.*, 1939, **31** (8), 993.—Experiments were made on the absorption of ammonia, hydrogen chloride, carbon dioxide, sulphur dioxide, and hydrogen sulphide from air. Various sized droplets of standard acid or alkaline solutions were used. The results obtained are in agreement with the theory of Johnstone and Kleinschmidt (*Amer. Inst. Chem. Engs*, 1938, **34**, 181). The application of the results to absorption and humidification is illustrated. P. D.

133.* **Direct Solution of *iso*Thermal Flow in Pipes.** B. F. Ruth. *Industr. Engng Chem.*, 1939, **31** (8), 985.—A method is devised by means of which flow problems may be solved without approximation in the turbulent region. In principle, the value for the unknown quantity which would be obtained if the flow were stream line is first calculated, and is then multiplied by a factor obtained from a chart, in order to give the actual value. P. D.

134.* Separation Processes: Analogy between Absorption, Extraction, Distillation, Heat Exchange, and other Separation Processes. M. Randall and B. Longtin. *Industr. Engng Chem.*, 1939, **31** (10), 1295.—The performance of an absorber may be represented graphically by constructions similar to those used for counter-current extractions (three-component systems). Either the familiar triangular diagram or the diagram drawn on impurity free basis may be used. These may also be transformed to x versus y diagrams.

In the case of heat exchange, an analogy may be drawn between the H *versus* N diagram for partly miscible phases and that in which the phases are immiscible or are made so by mechanical means, as in a heat exchanger. The graphical construction for such a case is indicated, so as to give the number of ideal heat-exchange units required for a given operation. P. D.

See also Abstract No. 203.

Chemistry and Physics of Petroleum.

135.* High-Octane *iso*Paraffinic Fuels. S. F. Birch, A. E. Dunstan, F. A. Fidler, F. B. Pim, and T. Tait. *Industr. Engng Chem.*, 1939, **31** (9), 1079–1083.—Preliminary work indicated the general nature of the sulphuric-acid-catalysed addition of olefines to *iso*paraffins, and was mainly concerned with the addition of butene to *iso*butane, since these hydrocarbons give the most promising results when translated into terms of commercial operation.

In the present paper the authors give the results obtained in several other olefine–*iso*paraffin condensation reactions.

Propylene has been induced to react with *iso*butane at 20° C., the most favourable yield being obtained by employing an *iso*butane–propylene ratio of 4 : 1 in the presence of sulphuric acid of 101·7% strength. Under these reaction conditions a 200% yield of gasoline based on the olefine taken was obtained, of bromine number less than 1, and having an octane number of 89·1. The major portion of the reaction product consisted of *iso*heptanes boiling at 80° and 90°, which from their physical properties appeared to be 2 : 4-dimethyl- and 2 : 3-dimethyl-pentanes, respectively. Definite fractions boiling at 58–61°, 99–100°, and 108–114° C. were also obtained. In the first of these, the *iso*hexane fraction, 2 : 3-dimethylbutane, was identified by formation of its solid dibromo-derivative. The material boiling at 99–100° C. was shown from physical properties to consist mainly of 2 : 2 : 4-trimethylpentane, whilst the less definite fraction (108–114° C.) consisted of other *iso*-octanes.

The addition of propylene to *iso*butane is therefore capable of producing a good yield of *iso*paraffinic hydrocarbons having a high-octane number. Commercial development of the reactions will be concerned, however, with the reduction of the high acid consumption.

Preliminary observations have been made on the condensation of trimethylethylene with *iso*butane.

Condensation of propylene with *iso*pentane proceeds smoothly in presence of excess of the latter to give a good yield of saturated product, consisting largely of *iso*paraffins in the C_8 to C_{10} range. The octane number, 73, of this material was disappointing and indicated the formation of long-chain paraffins. The major portion of the reaction product consisted of *iso*-octanes, probably 2 : 3-, 2 : 4-, and 2 : 5-dimethyl-hexanes. 2 : 3-Dimethylbutane was again identified in the C_6 range, whilst both 2-methyl and 3-methyl-pentane appeared to be present.

The acid consumption in this reaction was also excessive.

Di*iso*butene and *iso*pentane (*iso*paraffin–olefine ratio of 8 : 1) reacted to give a saturated hydrocarbon product of 79·7 octane number. The major portion of the reaction product consisted of hydrocarbons in the C_8 to C_{10} range, and contained a remarkably high *iso*hexane fraction, whilst formation of *iso*octanes was surprisingly small. Both 2 : 3-dimethylbutane and 2 : 2 : 4-trimethylpentane were identified, whilst the following hydrocarbons also appear to be present in the reaction product: 2- and 3-methylpentanes, 2 : 4-dimethylpentane, 3-methylhexane, 2 : 2 : 5-trimethylpentane, and 2 : 2 : 6-trimethylpentane.

2-Butene and *iso*pentane gave a condensation product of 85 octane number, the main fraction of which consisted principally of 2 : 2 : 5-trimethylhexane; the presence

of 2 : 2 : 6-trimethylhexane and 2-methylpentane was indicated, whilst 2 : 3-dimethylbutane was again isolated and identified through its *trans*-derivative.

Of these reactions the most promising from a commercial point of view appear to be the acid condensation of propylene with *iso*butane and of butenes with *iso*pentane. In general, the acid consumption for reactions involving propylene or *iso*pentane are considerably higher than those for butene–*iso*butane additions; in consequence the technical development of these reactions must await reduction in the acid requirements.

H. E. T.

136.* Catalytic Effect of Metals on Paraffin Hydrocarbons. C. L. Thomas, G. Egloff, and J. C. Morrell. *Industr. Engng Chem.*, 1939, **31** (9), 1090.—This paper presents a comprehensive summary of the catalytic effect of metals on the paraffin hydrocarbons. From considerations of the data presented it is concluded that as catalysts, metals are potentially capable of fostering carbon–carbon scission or cracking, dehydrogenation to form olefines, and complete decomposition to carbon and hydrogen. From the data there appears to be no metal that sponsors catalytic cracking or carbon–carbon scission. There is evidence that both copper and palladium are capable of sponsoring dehydrogenation to produce olefines, although copper is comparatively inert unless specially prepared, whilst palladium has a tendency to promote carbon formation. Iron, nickel, and cobalt are extensively active catalysts in promoting complete decomposition to carbon and hydrogen, but are rapidly poisoned by sulphur compounds.

H. E. T.

137.* Catalytic Hydration of Olefines. W. B. Shimer, M. M. Holm, and L. F. Brooke. *Industr. Engng Chem.*, 1939, **31** (9), 1099.—Sulphuric acid has been shown to be an active catalyst for the hydration of ethylene and propylene to the corresponding alcohols, at relatively low temperatures, where the equilibrium is favourable for high yields of alcohols. Optimum acid concentrations and temperature were 70% and 150° C. for ethylene and 55% and 115° C. for propylene hydration. Under these conditions the equilibrium constants for alcohol formation were $Kp = 0{\cdot}049$ for ethylene hydration and $Kp = 0{\cdot}1$ for propylene hydration, values which agree with published data. Pressure operations increased the rate of alcohol production, and concentration of alcohol in the product, but decreased the amount of water required for maintaining the acid concentration constant. The ratio of ether to alcohol in the product was increased for ethylene hydration, but not for propylene hydration by operating under pressure.

H. E. T.

138.* Raoult and Dalton's Laws Demonstrated in Vapour-Pressure Apparatus. J. A. Campbell. *Petrol. Engr*, Sept. 1939, **10** (13), 96.—A complete understanding of Raoult and Dalton's laws is essential to an appreciation of the methods used in the extraction of natural gasoline. A simple demonstration of these two laws using a Reid vapour-pressure apparatus is described. Tests in which the air/liquid ratio is varied show that natural gasoline is a mixture, the changes in pressure experienced being due to changes in the composition of the liquid with evaporation which could not occur with a pure substance. A modification of the Reid apparatus is used to demonstrate the effectiveness of absorption oil as compared with compression alone in condensing natural gasoline and at the same time illustrate Raoult's Law.

R. J. E.

139.* Sulphonation of Naphthenic Acids. W. Kisielewicz, S. Pilat, and J. Sereda. *IIme Congrès mond. Pétrole*, 1938, **2**, 435–439.—The author reviews the very contradictory literature relating to the sulphonation of naphthenic acids and describes his experiments using fuming sulphuric acid and naphthenic acids of varying molecular weights. Preparation, purification, and sulphonation are described, and it is shown that (1) the higher the molecular weight, the more easy the sulphonation, (2) for equal molecular weight those acids with higher density and higher refractive index react more easily, (3) the sulphonation does not break down the carboxylic group.

W. P.

140.* New Structural Principles in the Synthesis of Oils. G. Hugel. *IIme Congrès mond. Pétrole*, 1937, **2**, 323–327.—Solutions of substances of high molecular weight,

particularly when the concentration is sufficiently high to cause gelling, possess properties which depend entirely on those of the solute. Applying this to viscosity–temperature characteristics of lubricating oils, the author advances a molecular structural theory to account for differences in viscosity index.

It is concluded that high viscosity indices are connected with long-chain structures.

W. P.

141.* Polymerization of Unsaturated Hydrocarbons. H. I. Watermann and J. J. Leeudertse. *IIme Congrès mond. Pétrole*, 1939, **2**, 313–322.—An account of research in the Laboratory of Chemical Technology, Delft Technical University, into the effect of structure of basic material and conditions of reaction in the catalytic polymerization of olefines and cyclic unsaturated hydrocarbons.

Polymerization of relatively pure hydrocarbons was effected at low temperatures, mainly with $AlCl_3$ as catalyst, and the products were examined for composition by the specific refraction molecular-weight method. It was shown that $AlCl_3$ is a powerful catalyst giving high yields of high molecular hydrocarbons, but that secondary reactions such as cyclization also occurred even at very low temperatures (—78° C.).

The cyclic character of a hydrocarbon mixture is not the only factor in determining its properties, the degree of branching being especially effective. Since the parachor is also connected with the degree of branching, the authors have compared the molecular composition of their hydrocarbons as determined by specific refraction with that given by the specific parachor. The two methods do not give identical results if the specific parachor of Sugden is used, but show satisfactory similarity if the atomic parachor of Mumford and Phillips is used. The parachor can therefore be used for assessing the apparent total cyclic character of the products of polymerization.

W. P.

142.* Thermal Transformation of Hydrocarbons. A. V. Frost. *IIme Congrès mond. Pétrole*, 1937, **2**, 175–182.—An account of the work undertaken in U.S.S.R. to elucidate the mechanism of thermal transformation of hydrocarbons, based on the work of Rice, who showed that cracking is a reaction in chain form in which the radical is an intermediary product.

The kinetics of thermal decomposition of paraffins and of polymerization of olefines are discussed with particular reference to the nature of the radicals involved.

W. P.

143. Viscosity and Its Measurement. Viscosity Index, Rigidity and Thixotropy. J. Suaton. *Bull. Tech. de la Soc. franc. Petrol.* 1939, No. 14, 10–17.—Definition of the absolute units of viscosity, the Poise, and the Stoke are given, and these are followed by brief descriptions of the absolute and commercial viscometers in use at the laboratories of the S.F. des P., together with practical hints on their use. Some notes on the Dean and Davis Viscosity Index System lead to mention of means of improving this property, such as solvent refining and the use of additives. Among considerations of the accurate measurement of viscosity in commercial instruments is the suggested use of standard oils for calibrating the Engler viscometer, in place of water, which gives turbulent flow in this instrument. Limits suggested for the time of flow for the following viscometers are: Engler not to exceed 1 hr.; Hoppler 30–300 secs.; Baume capillary tube type 100–300 sec. Discussing the phenomenon of hysteresis, attention is directed to the influence on this property of compounds such as sulphonates. A thixotropic system is defined as one which can pass, as a result of mechanical agitation, from a rigid to a non-rigid state after a period of rest. The principles of Schwedoff's torsion wire method of measuring rigidity are outlined, and the article concludes with Michand's definition of rigid liquids.

J. L. T.

144.* Crystal Structure of Hexamethylbenzene and The Length of The Methyl Group Bond to Aromatic Carbon Atoms. L. O. Brockway and J. M. Robertson. *J. chem. Soc.*, Aug. 1939, 1324–1332.—The authors have repeated the determination of the crystal structure of hexamethylbenzene using the double Fourier series method of interpreting the intensity data, with the following results. The distances to the centre

of the molecule are 2·92 Å., which, with measurements on the ring, lead to a ring size of 1·39 Å. and a length of 1·53 Å. for the methyl group bond. Thus the methyl group bond attached to a wholly substituted benzene ring has the same length as in a saturated aliphatic hydrocarbon. Between carbon atoms the minimum intermolecular approach distances are 3·70–3·8 Å., and between hydrogen it is 2·0–2·2 Å. The (001) layer is very nearly hexagonal; nevertheless the structure is not monoclinic, but triclinic, since this allows the layer spacing to decrease, corresponding to an increase of about 9% in the density. R. D. S.

145.* Viscosities of Chemically Related Liquids and Their Dependence on Molecular Weight and Molecular Volume. Part II. D. T. Lewis and A. R. Morgan. *J. chem. Soc.*, Aug. 1939, 1341–1345.—The authors reason that even in the liquid state molecular volume and molecular weight exercise a profound influence on viscosity, and should be introduced into any equation intended to represent the variation of viscosity with other physico-chemical constants; and from results of viscosities on series of chemically-related liquids derive an equation combining these fundamental characteristics, showing that when all operative essentials are taken into account, fluorobenzene does not behave anomalously in the halogenobenzene series. Fused silver halides, when plotted according to the equation, give constant slope in the same manner as the homologous liquids, although doubtful parachor values of these salts prevent conclusions as to the effect of molecular volume being reached with certainty. The authors argue that the similar nature of the equations for liquids and gases is to be expected, since in such equations there must be basic dimensional resemblances between liquids and gases. R. D. S.

146.* Kinetics of Bromine Addition to Olefinic Compounds. Part II. The Homogeneous Mechanisms. I. K. Walker and P. W. Robertson. *J. chem. Soc.*, Sept. 1939, 1515–1518.—Bromine is added at a termolecular rate to olefins in acetic acid at 25° at concentrations about M/40, the heat of activation being low, but there is also a bimolecular reaction to a smaller extent. When however, the concentration decreases, the heat of activation increases and the bimolecular mechanism gradually replaces the termolecular, until, at concentrations of M/1000, the change-over is almost complete for allyl derivatives. When about 25% of water is added, the bimolecular reaction again predominates with increased heat of activation, and, similarly, increase in temperature causes the same effect. R. D. S.

147.* Kinetics of Chlorine, Iodine Chloride and Bromine Chloride Addition to Olefinic Compounds. E. P. White and P. W. Robertson. *J. chem. Soc.*, Sept. 1939, 1509–1515.—An account is given of measurements of the rate of addition of chlorine, iodine chloride, and bromine chloride to certain olefins in acetic acid solution and, in some cases, nitrobenzene. While iodine and bromine monochlorides undergo termolecular addition in the same way as do iodine and bromine, the mechanism of chlorine addition was found to be bimolecular in dissociating solvents. Suggested explanations for the termolecular mechanisms are put forward, involving the formation of certain addition compounds, and anomalies in the chlorine addition are considered. R. D. S.

148. Investigations on The Stereoisomerism of Unsaturated Compounds IV. The Identification of *cis-trans* Isomers by Rate Studies. W. G. Young, D. Pressman, and C. D. Coryell. *J. Amer. chem. Soc.*, 1939, **61**, 1640–1644.—In this paper are presented specific reaction rate constants and the heats of activation of the reaction of potassium iodide with several pairs of stereoisomeric alkene dibromides in 99% methanol at 75° and 60°. Acetone was used in place of methanol in the case of the stilbene dibromide isomers owing to the slight solubility of the *trans* form in methanol, which form was found to react over 100 times as rapidly as the *cis* form.

In those derivatives in which the parent unsaturated compounds have two hydrogen atoms adjacent to the double bond and the other two groups are identical or similar, the dibromide from the *trans* compound was found to give a greater rate constant and a smaller heat of activation than the dibromide from the *cis* isomer. The authors therefore suggest that the rate studies of this nature offer a useful means of identifying the isomers of alkene hydrocarbons which cannot be readily identified by the usual methods of ring-splitting, ring-formation, and so on. R. D. S.

149. Investigations on The Stereoisomerism of Unsaturated Compounds V. A Mechanism for The Formation of Butenes from 2 : 3-Dibromobutanes by The Action of Iodide Ion. S. Winstein, D. Pressman, and W. G. Young. *J. Amer. chem. Soc.*, 1939, **61**, 1645–1647.—The removal of bromine from *dl*- and *meso*-2 : 3-dibromobutanes by iodide ions was performed by treatment with sodium iodide in propanol and with potassium iodide in diethylene glycol. The authors found that the removal of the bromine involves almost entirely *trans* elimination at moderate temperatures, and that considerable rearrangement occurs also at a higher temperature.

The mechanism suggested is that the iodide ion attacks one of the (positive) bromine atoms, donating electrons to give iodine bromide, what time the unshared pair of electrons attack the carbon face opposite the remaining bromine atom, liberating bromide ion. A double bond thus being formed, the process is therefore *trans* elimination of bromine. R. D. S.

150. Peroxide Effect in The Addition of Reagents to Unsaturated Compounds. XX. Addition of Hydrogen Bromide to 2-Butyne and 2-Bromo-2-Butene. C. Walling, M. S. Kharasch, and F. R. Mayo. *J. Amer. chem. Soc.*, 1939, **61**, 1711–1713.—2-Butyne treated with hydrogen bromide in certain definite conditions free from oxygen and peroxide gave a normal addition, 2 : 2-dibromobutane being formed, but in conditions of peroxide catalysis racemic 2 : 3-dibromobutane was obtained. The latter product was also obtained when the normal addition was retarded by dilution with an inert solvent (pentane); thus we have a case of abnormal addition to a terminal double bond. (2-Bromo-2-butene is the product of addition of one molecule of hydrogen bromide to 2-butyne under all conditions and, being intermediate, was therefore not isolated in the course of these experiments.) R. D. S.

151. Isomerization of Cyclohexane and Methylcyclopentane. A. L. Glasebrook and W. G. Lovell. *J. Amer. chem. Soc.*, 1939, **61**, 1717–1720.—The isomerization, *cyclo*hexane ⇌ methyl*cyclo*pentane, having had conflicting reports regarding the nature of the rearrangement and side products, was investigated at temperatures in the liquid phase at 10° intervals from 25° to 77·4° (boiling temperature), the equilibrium being approached from both sides. The investigators found anhydrous aluminium chloride to be inert towards the hydrocarbons, but in the presence of water or hydrochloric acid it brought about a clean reaction with no formation of gas or tar. With aluminium bromide, however, a tarry layer was formed and *iso*butane was evolved. The course of the reaction was followed by refractive index determinations, which indicated only 5% of *cyclo*hexane used in formation of products of side reactions, isomerization thus being almost the sole reaction. Equilibrium constants were measured, and the values of the free energy change, heat of reaction, and entropy change computed therefrom and compared with values calculated from heat-capacity data. R. D. S.

152. Isomerization of Alkenes on Alumina and Thoria. S. Goldwasser and H. S. Taylor. *J. Amer. chem. Soc.*, 1939, **61**, 1762–1765.—The investigators found that isomerization was not affected by the mode of preparation of the catalyst, two different preparations of alumina being shown to have comparable effects. The change in rate of passage of an alcohol over a dehydrating catalyst (vide *J. Amer. chem. Soc.*, 1939, **61**, 1751–1761; *J. Inst. Petrol.* Abstr. No. 1216, 1939) produced a change in distribution of isomers due to isomerization of the products themselves, and not to a change in the mechanism of dehydration. The authors have determined the products of isomerization at 400° for several olefins, and have compared the rates of isomerization on thoria and alumina, postulating a mechanism to account for the products of isomerization, this being based on the formation of an intermediate 3-carbon ring structure similar to that proposed for the catalytic dehydration of alcohols (*loc. cit.*). In addition, comparative stabilities of some olefins at 400° are given. R. D. S.

153. Aromatization of Heptane, Heptene, and Hexene Isomers on Chromic Oxide. S. Goldwasser and H. S. Taylor. *J. Amer. chem. Soc.*, 1939, **61**, 1766–1769.—This investigation presents a study of the effects of structure and rate of passage of hydrocarbons on the reactions occurring in ring-closure and aromatization. The authors

have studied the dehydrogenation of *cyclo*hexene and 1 : 3-*cyclo*hexadiene on chromic oxide gel surfaces, and demonstrate the influence of the character of the catalyst on aromatization; thus, for aromatization of an aliphatic hydrocarbon a dehydrogenating catalyst must be employed. The effect of the structure of an olefin is also shown and discussed. R. D. S.

154. Hydrogen Fluoride as A Condensing Agent. VII. The Acylation of Aromatic Compounds. J. H. Simons, D. I. Randall and S. Archer. *J. Amer. chem. Soc.*, 1939, **61**, 1795–1796.—The authors demonstrate the effectiveness of hydrogen fluoride in the synthesis of ketones from aromatic compounds and carboxylic acids, acid anhydrides and acyl halides by a series of acylating reagents even when ordinary commercial grades of reagents are employed. The yields increase with increasing amounts of hydrogen fluoride. R. D. S.

155. Diphenylmethane as A Thermometric Standard at 25°. T. De Vries and H. A. Strow. *J. Amer. chem. Soc.*, 1939, **61**, 1796–1798.—The authors report a melting point of 25·09 ± 0·01° C. for pure diphenylmethane, noting that a spontaneous decomposition occurs which is accelerated by light and which results in a progressive depression of the melting point. R. D. S.

156. Relation Between Fluidity, Temperature, and Chemical Constitution of Pure Liquids. E. C. Bingham and S. D. Stookey. *J. Amer. chem. Soc.*, 1939, **61**, 1625–1629.—In this paper is discussed a simple equation $\phi/T = a + bT + \ldots$, which is claimed to be accurate, expressing a definite relationship between temperature and viscosity, and affording a well-defined regularity in the viscosity–temperature functions of the successive members of an homologous series up to ten carbon atoms. ϕ is the fluidity in RHES (reciprocal poise) and T is the temperature in degrees absolute; constant a is a function of the homologous series, and constant b is a function of the molecular weight of the particular member of the series to which the equation is applied. The equation is shown to be valid for a large number of classes of liquids, the only class which the authors found not to fit it being the alcohols. From it a modified equation is derived in which constant a (found to be almost identical for all members of any one non-associated homologous series) is averaged for that series, and constant b is expressed as an exponential function of the molecular weight within the series. Thus it is possible to calculate the viscosity of any member of a non-associated series up to ten carbon atoms at any temperature by means of only four constants. R. D. S.

157. The Viscosity Function. II. Viscosity and Constitution. E. P. Irany. *J. Amer. chem. Soc.*, 1939, **61**, 1734–1739.—The greater number of pure chemical compounds are non-associated in the pure liquid state; the author therefore reasons that when laws of constitutional additivity such as viscosity are deduced, the inclusion of an association factor to accommodate the facts to such empirical relationships has no meaning, but the intermolecular forces, expressed in some way, must be included in the concept of constitution. By further argument, the author limits to two, as a minimum, the number of material factors which are necessary to postulate a rule of constitutive viscosity, so that single atomic constants are not sufficient for such a rule. However, the simpler the structure of chemical compounds, the more difficult becomes the problem, because among them every structural difference is large enough to obscure all physical relationship. Additive increments occur only in certain series of homologous substances in which the intermolecular forces are either (*a*) negligible, as in non-polar compounds, the paraffins, for example, or (*b*) constant for all members, as in polymer-homologues, composed of a large and variable number of identical polar groupings. In a graphical study on the latter class, the author deduces two parameters, one, constant, expressing the common polar nature of all members of the series, and the other, constitutionally additive, dependent on molecular weights, volumes, chain lengths, and so on. R. D. S.

158.* Fractionation of Mixtures of Hydrocarbons. H. Macura and H. Grosse-Oetringhaus. *Oel u. Kohle*, 1939, **15**, 591–600.—A detailed account is given of the fractionation of mixtures of benzene, toluene, and xylene, using columns of different

types and with various packings. Results are quoted to show the effect of different packings on the efficiency of a column, and also the effect of different rates of distillation. Using the final column described, it is claimed that the distillation curve shows quite clearly the presence of the toluene in a mixture of 10% benzene, 0·5% toluene, and 89·5% xylene. T. T. D.

159.* Chlorination of Olefins and Olefin–Paraffin Mixtures. H. P. A. Groll, G. Hearne, F. F. Rust, and W. E. Vaughan. *Industr. Engng Chem.*, 1939, 31, 1239.—From a study of the chlorination of the C_2, C_3, and C_4 olefins under flow conditions, it is concluded that at temperatures below 150° C. in the gas phase the chlorination reaction is extremely slow, but in the presence of the liquid phase the reaction is rapid. Under this latter condition the substitution of chlorine into the saturated addition product or into a concurrently present paraffin is inhibited by the presence of oxygen, the paraffin reaction being more strongly influenced. The quantitative distribution of the chlorination products from the reactions studied are given.

Catalytic vapour phase chlorination of olefins and olefin–paraffin mixtures occurs at moderate temperatures in the absence of liquid, and the concurrent substitution reactions are not inhibited by the presence of oxygen. J. W. H.

160.* Trimethylhydroquinone from a Petroleum Product. W. M. Potts and H. N. Morrow. *Industr. Engng Chem.*, 1939, **31**, 1270.—A description is given of the isolation and identification of trimethylhydroquinone from a spent soda solution that had been used in the treating of the cracked product from a Samfordyce crude oil.

Summarized experimental data and photomicrographs of the identification derivatives are given. J. W. H.

161.* Anti-oxidants for Castor Oil. G. O. Inman. *Industr. Engng Chem.*, 1939, **30**, 1103.—The effect of the addition of anti-oxidants to castor oil has been examined by passing oxygen at 60 c.c./hr. at 125° C. through 25 gm. of castor oil containing 0·1% of the substance under test. The increase in stability conferred upon the oil by the presence of the anti-oxidant was determined by measurement of the acidity after various periods of time.

Of the 21 substances examined, many were shown to be pro-oxidants. The most efficient anti-oxidants were pyrogallol, hydroquinone, and catechol. J. W. H.

162.* Chemical Reactions of Cracked Residues. H. Tropsch, C. L. Thomas, J. C. Morrell, and G. Egloff. *Industr. Engng Chem.*, 1939, **30**, 1112.—The reaction products produced from cracked residues by the processes of oxidation, sulphonation, ethylation, nitration, and condensation are briefly reviewed, and the conclusion is reached that certain of these reactions may offer useful leads for research in the development of products from cracked residues. J. W. H.

163.* Vapour-Liquid Equilibrium in the System Propane-Isobutylene. H. W. Scheeline and E. R. Gilliland. *Industr. Engng Chem.*, 1939, **31**, (8), 1050.—The equilibrium was measured at pressures up to 600 lb. per sq. in. The experimental results are compared with the equilibrium constants calculated from fugacity. Good agreement is found at 400 lb. per sq. in. At lower pressures the polarity of the *iso*butylene, which is responsible for lack of ideality of the solution, results in higher values of K for propane than those calculated. The values of K for *iso*butylene show serious divergences as the critical state is approached. P. D.

164. Motion of Cylindrical Particles in Viscous Flow. R. C. Binder. *J. Appl. Phys.*, 1939, **10** (10), 711.—Experiments were made on the orientation of cylindrical particles in glycerin, using a concentric cylinder viscometer. Two different final orientations of the particle were observed—namely, perpendicular and parallel to the plane of undisturbed flow. The relation between final orientation and length-diameter ratio of the particle was determined for different speeds. The results are considered in the light of theory. P. D.

165. Viscosity of Dilute Solution of Long-chain Molecules. M. L. Huggins. *J. Appl. Phys.*, 1939, **10** (10), 700.—Equations are given for the specific viscosity of dilute solutions of randomly-kinked chain molecules which is of the same form as Staudinger's empirical equation. The equation is tested against experimental determinations on solutions of normal paraffins. The various factors which may be expected to affect the accuracy of the equation are discussed. P. D.

166.* Phase Equilibria in Hydrocarbon Systems: Joule-Thomson Coefficients of Gaseous Mixtures of Methane and Ethane. R. A. Budenholzer, B. H. Sage, and W. N. Lacy. *Industr. Engng Chem.*, 1939, **31** (10), 1298.—Joule-Thomson coefficients were determined at 70°, 100°, 160°, and 220° F., over a pressure range 40–1500 lb. per sq. in. for three CH_4–C_2H_6 mixtures (23·6, 40·0, and 73·3 mol % C_2H_6). The results are presented in tabular and graphical form, and the *iso*baric heat capacity is calculated. P. D.

Analysis and Testing.

167. A Hydrogen Sulphide Recorder. W. E. Stackhouse. *Instruments*, 1939, **12** (10), 280.—The recorder described works on the principle of determining the H_2S content of a sample of gas by means of a colorimetric reagent, the colour intensity being measured by photocells in conjunction with a potentiometer type recorder. The recorder will respond to changes in concentration of 0·005 grain H_2S in 100 cu. ft. The range can be varied to suit requirements. P. D.

168.* Evaluation of High-Octane-Number Gasolines. L. A. Peletier and S. G. Van Hoogstraten. *Monit. Pétr. roum.*, 15.7.39, **40** (14), 947–950.—This article describes a method of testing the anti-knock properties of fuels of high octane number by the use of which it is claimed that good correlation with results obtained in current aero engines can be obtained. The method is a simplification in some respects of the "Allowable Boost Ratio" method of test described by one of the authors *et. al.* in *Aircraft Engineering* of December 1935. The present method compares the boost pressures permissible at different mixture strengths on the fuel under test at a fixed compression ratio with that obtained on a standard reference fuel such as *iso*-octane to give incipient detonation, the results on the test fuel being expressed as a percentage of the value obtained on the reference full at 1·1 times theoretical mixtures strength for complete combustion.

The equipment used is a modified C.F.R. engine coupled to a synchronous motor and a separate unit for the supply of air to the engine at closely controlled pressures.

As regards the engine, the variations from the standard C.F.R.-A.S.T.M. equipment are as follows:—

Aluminium piston (Waukesha No. 105,590) with clearance increased by 0·1 mm. to obviate seizure.

Inlet valve plain in place of A.S.T.M. shrouded valve.

Highlift camshaft (Waukesha No. 23223).

Standard carburettor choke increased from 14 to 23 mm. and variable jets fitted.

Mixture heater (K.L.G. No. 583; the heat input being maintained constant and equal to that required to raise the mixture temperature to 90° C. when running on *iso*-octane at 10% rich with no supercharge).

Evaporative cooling using water/glycol mixture boiling at 120° C.

Ignition 30° BTC.

The above test conditions are considered to give the best results, and the reasons for their adoption are discussed. The air-supply apparatus operates from a high-pressure supply and allows of fine adjustments, permitting the boost pressure to be maintained constant to within 1 mm. Hg.

The high-pressure supply can be varied between approximately 28½ and 36 lb. per sq. in. absolute, and the supply to the engine is adjustable between 11½ and 21½ lb. per sq. in. absolute. Details of the air supply equipment are given in an appendix.

This method of test has been found to give results repeatable within very small

limits of experimental error, and in this respect is claimed to be greatly superior to the A.S.T.M. method in the region of 100 octane. In addition, it would be possible to extend the range of the method by the use of reference fuel superior to *iso*-octane.

C. H. S.

169. Trichloroethylene as a Solvent in the Bituminous Laboratory. J. D. Brown. *Proc. Assoc. Asph. Paving Techn.*, 1939, 266–279.—The author points out that although carbon disulphide must be used in the determination of bitumen content in accordance with the definition of bitumen, it is not a satisfactory solvent for routine laboratory use, and it is suggested that for most purposes this solvent could be replaced by trichloroethylene. A comparison is made of the properties of carbon disulphide, carbon tetrachloride, and trichloroethylene and of the behaviour of these solvents when used in various tests on bituminous materials. Solubility tests made in accordance with the A.S.T.M. methods for total bitumen and for solubility in carbon tetrachloride showed no marked difference in the case of road oils, paving bitumens, a blown bitumen, Gilsonite, and three rock asphalts. A very hard bitumen gave similar results with carbon disulphide and trichloroethylene, but showed approximately 8% lower solubility in carbon tetrachloride, whilst coal tars showed slightly lower solubility in trichloroethylene than in carbon disulphide and appreciably lower solubility in carbon tetrachloride. No great difference was found in the rates of solution of bitumens in carbon disulphide and trichloroethylene, but carbon tetrachloride was much slower. The relative rates of evaporation were of the order of 4·1, 1·6, and 1·0 for carbon disulphide, trichloroethylene and carbon tetrachloride. It is pointed out that the flash point of carbon disulphide is very low and that the auto-ignition temperature is about 130° C. In conclusion it is stated that trichloroethylene appears to be a satisfactory substitute for most purposes and worthy of serious consideration as a general bituminous solvent, being superior to carbon tetrachloride in stability, solvent power and rate of solution, less volatile and probably less toxic.

A. O.

170. New Methods of Testing Liquid Fuels. F. Seeber. *Luftfahrtforsch.*, 1939 (16), 431–433.—A drawback in the routine testing of motor fuels in the C.F.R. engine is the known fact that spirits giving the same octane number in this engine often show different ratings in the actual aircraft engine. The Deutsche Versuchs Anstalt fuer Luftfahrt (D.V.L.) have developed a new method of knock-rating based on the intake pressure or pressure of the charge at which the first knock is audible, the test being run in a single cylinder of a full scale engine.

With this method it is claimed to be possible to introduce optionally one or more variables during the test—viz., compression ratio, ignition timing, air/fuel ratio, intake air temperature, temperature of the cooling medium, and engine speed, the octane value being made up in the form of curves taken under widely different conditions, but always in the real cylinder. It was possible to solve certain problems of fuels of similar C.F.R. rating but of different chemical structure, as, for instance the different temperature sensitiveness of paraffinic fuels as opposed to aromatic fuels.

E. W. S.

171. Determination of the Mercaptan Sulphur in the Calorimetric Bomb. E. Dittrich. *Brennstofftechnik*, 1939, **20**, 348–349.—The lower aliphatic mercaptans present in mineral oils can only be definitely found with the calorimetric bomb if the combustion is effected at a starting pressure of at least 500 lb./sq. in., and if the mercaptans are strongly diluted. On the other hand, exact results can only be established with combustion in the quartz tube according to Grote and Krekeler.

E. W. S.

Motor Fuels.

172.* Vapour-lock Properties of Motor Fuels. Th. Hammerich. *Oel u. Kohle*, 1939, **15**, 569–577.—Vapour-lock properties of fuels are controlled, in America, by Reid vapour-pressure measurements and the determination of the 10% recovery point in the A.S.T.M. distillation. These methods have not been adopted generally in Germany, as the results obtained do not accord well with practice. In order to correlate these

properties with the constitution of the fuel, the author has worked out a new method of separating the C_3 and C_4 hydrocarbons, using "fractional dephlegmation." The sample is first submitted to a modified A.S.T.M. distillation in which the first 25% is received in a long-necked round-bottom flask, completely immersed in a bath at $-80°$ C., the condenser tube being fitted through a rubber bung to an adaptor connected to the neck of the receiver by a ground-glass joint. The receiver is then removed from the cooling bath and connected to the bottom of a column packed with aluminium spirals. This column is surrounded by a bath, which is maintained at the desired temperature, thus acting as the dephlegmator, and is connected at the top through a two-way tap to two calibrated tuning-fork shaped receivers immersed in baths at $-80°$ C.

To separate the C_3 fraction, the temperature of the dephlegmator is adjusted to $-35°$ C., the tap to one of the tared receivers opened, and the flask heated with a micro-burner. When the volume in the receiver ceases to increase, the receiver is disconnected and weighed. To determine the C_4 fraction, the tap to the second receiver is opened and the temperature of the dephlegmator adjusted to 3° C., until the volume in the receiver ceases to increase, when the latter is disconnected and weighed. As the sample was weighed before the preliminary distillation, the percentage of the C_3 and C_4 hydrocarbons can be calculated. Work on samples of known composition showed that this method gave reliable results, so it was used as the standard method of analysis.

Since the appearance of vapour-lock may depend on factors other than volatility, the author describes a method of determining the lock (Abreisst) temperature. In this the fuel under test is forced, at 10 litres/hour, by means of a membrane pump through a copper spiral immersed in a water-bath. Means are provided for heating the bath, and the temperature of the fuel in the spiral at the moment when a vapour-lock occurs (rate of flow $< 1{\cdot}5$ l/hr.), is the lock temperature.

Tables and diagrams are given illustrating the effect of the addition of C_3 and C_4 hydrocarbons on the vapour pressure, A.S.T.M. 10% point and lock temperature of I.G. standard benzine, and the same properties are recorded for mixtures of gasoline, alcohol, and benzene. These figures show that there is an approximately linear relationship between lock temperature and A.S.T.M. 10% point in the case of most gasolines, but this does not hold for benzene or alcohol mixtures, or for gasolines rich in C_3 and C_4 fractions.

On this account, the author proposes, as a more reliable guide to vapour-lock properties, the mean of the recovery to 50° C. and to 70° C., which is reported as the volatility and expressed as a percentage.

When volatility is plotted against lock temperature, straight lines are obtained for fuels of equal vapour pressure. If plotted on one diagram, the lines corresponding to different vapour pressures form a pencil of rays, the slope (tan α) being a function of vapour pressure. The author includes a graph of this relationship, and thus, if the volatility (v) is known, the lock temperature (l) is obtainable from the equation

$$l = \frac{30 - v + 48}{\tan \alpha}$$

Hence, from measurements of Reid vapour pressure and determination of the A.S.T.M. distillation curve, it is possible to calculate the lock temperature, which is a direct measure of the vapour-lock tendencies of the fuel. T. T. D.

173.* Producing High-Octane Aviation Gasolines by Means of Destructive Alkylation. D. L. Goldstein and B. A. Englin. *Neft. Khoz.*, July 1939, **20** (7), 27–34.—In the process of destructive alkylation, with benzole present, the anti-knock properties of low-octane fuels are improved. A liquid residual complex of aluminium chloride with hydrocarbons is formed which flows freely at low temperatures, thus facilitating the technological development of the necessary full-size apparatus. Destructive alkylation in the presence of benzole proceeds under milder temperature conditions than the usual process of treating petroleum products with aluminium chloride to a solid residue. In the present experiments destructive alkylation was carried out between 150° and 200° C.

As raw materials were used : Grosny paraffin-base aviation gasoline, synthin (consisting mainly of normal paraffinic hydrocarbons), and products of Ishimbaevo crude.

It has been found that the heavier the raw material, up to a certain limit, the more intense is the reaction, and the greater the quantity of alkyl benzole formed. For example, optimum anti-knock properties result with a synthin having a f.b.p. of 220° C. In the destructive alkylation of products of Ishimbaevo crude, parallel with the formation of high-octane gasolines, the latter are also desulphurized.

From Grosny gasoline a fuel is produced having 95·5 octane number with 3 cu. cm./kgm. ethyl fluid. From synthin a fuel is obtained which has 85 octane numbers when 2 cu. cm./kgm. ethyl fluid are added, whilst octane numbers of the products of treatment of Ishimbaevo gasoline containing 2 cu. cm./kgm. $PbEt_4$ range between 89·5 and 92 octane.

The anti-knock properties indicated are not the optima obtainable, and the possibility of further improvements is being investigated. L. R.

174.* Production of Anti-Knock Fuels from Oil of Turpentine. G. Hugel. *IIme Congrès mond. Pétrole*, 1937, **2**, 309–312.—The principal constituents of French oil of turpentine are α- and β-pinene. The various known methods of converting pinene into cymene either by dehydrogenation or by oxidation are discussed. The author advocates heating oil of turpentine, with sodium as catalyst, to a temperature of 270° C., when a mixture of about one-third menthane and two-thirds *p*-cymene is produced. This, by nitration and reduction, yields amino-cymene, which has already been noted for anti-knock properties. W. P.

See also Abstract No. 102.

Diesel Oil.

175.* Transformation, Spontaneous Ignition and Cetene Numbers of Diesel Fuels. O. Herstad. *Oel. u. Kohle*, 1939, **15**, 629–631).—" Transformation " curves have been determined for the two reference fuels supplied for cetene number determinations by the A.I.O.C. Whereas in the case of gasolines the maximum transformation occurs between 160° C. and 230° C., for diesel oils the range is from 350° C. to 400° C. Further, whilst in the former case maximum transformation temperature rises with increasing octane number, in the latter case maximum transformation temperature falls with increasing cetene number, and the maximum transformation time (in sec./c.c.) falls from 56 in the case of the high cetene standard to 38 in that of the low cetene standard.

The transformation curves of mixtures of the two fuels were also determined, and it is shown that there is an approximately linear relationship between maximum transformation time and composition, analogous to that between cetene number and composition.

Spontaneous ignition temperatures of mixtures of the two standard fuels were also determined, covering the range 600–560° C., and it is shown that there is a linear relationship with cetene number, which with the mixtures in question varied from 43 to 71. The desirable cetene number range of 51–64 corresponds to S.I.T. of 590–570° C. T. T. D.

Lubricants and Lubrication.

176.* Reclamation of Used Lubricating Oil. S. H. Wilson and M. B. Rands. *New Zealand J. Sci.*, 1939, **21**, 1B–15B.—New Zealand imports all its requirements of lubricating oil, and 68% of the total quantity is used in I.C. engines fitted to land vehicles. It is considered that the better oils demanded by modern engines are produced by solvent refining, and are worth reclaiming. In peace-time, regeneration by methods used in the original refining may not be economical, but in war-time, regeneration may be desirable to conserve supplies. The main benefit to be obtained from the use of reclaiming is thought to be the improved running and longer life of the engine consequent on more frequent draining of the sump oil. The English method of reconditioning by batch methods of washing, heating and settling, chemical treatment for coagulating impurities, pad and edge filtration and centrifuging, are contrasted with German methods of reclaiming using acid and earth treatment. It is pointed out

that a strict comparison between new and reclaimed oil is not possible, since in practice fresh oil is always being added. The warning is made that natural inhibitors present in moderately refined oil are removed by further refining, and that more refined oil oxides more rapidly in consequence. The methods of examining used oil adopted in New Zealand are the usual ones, plus the precipitation of suspended inorganic matter by trichlorethylene. Metallic soaps are not precipitated. Analyses are given of used oils from tractors, one oil containing the familiar aluminium soap detergent, and also from trucks using filters packed with cotton waste. It appears that there is no saving in cost of oil, but that the benefit is found in lower wear and better running of the engine. J. L. T.

177.* Comparison of the Low-temperature Behaviour of Petroleum and Synthetic Lubricating Oils. R. Heinze and M. Marder. *Oel u. Kohle*, 1939, **15**, 611–616.—The power required to drive a 10–50-h.p. Mercedes-Benz engine at 40 rev./min. was determined in watts/rev. at temperatures between 0° C. and —20° C., by enclosing the engine and the electric motor required to drive it in a refrigerator. Four petroleum and two synthetic oils were used, and the variation in the power required with temperature was measured in each case.

Viscosities determined directly on the Vogel–Ossag instrument at the temperatures concerned were not in good agreement with those calculated with the help of the Ubbelhode–Walther viscosity-temperature chart, and neither was in quantitative agreement with the actual behaviour of the oil in the engine. Although the extrapolated figure is not completely unreliable regarding the actual behaviour of the petroleum oil, neither is of great significance in forecasting the behaviour of the synthetic oil.

In contrast to this, the figures obtained by means of the Schwaiger rotating cylinder viscometer are in very good agreement with the actual behaviour of the oils over the same low-temperature range. The synthetic oils proved themselves better in the engine and in the Schwaiger viscometer than their behaviour in a capillary viscometer would lead one to expect. On the other hand, the figures obtained on the Vogel–Ossag lead to an over-valuation of the usefulness of petroleum lubricating oils at low temperatures.

The authors emphasize that their results show that the synthetic oils have better low-temperature properties in the engine than do petroleum oils of equal viscosity at 50° C. This behaviour is, apparently, independent of the viscosity pole height, for figures are quoted to show that two oils, one synthetic of viscosity 68 centistokes at 50° C., the other petroleum of viscosity 48 centistokes at 50° C., and of pole height 1·93 and 1·89, respectively, have almost identical curves for performance between 0° and —20° C. Since the synthetic oils have, in general, flat viscosity curves, the authors consider that, for motor lubrication, they are greatly to be preferred to the more usual petroleum lubricants. T. T. D.

178.* Modern Grease-making. F. E. Huggins. *IIme Congrès mond. Pétrole*, 1938, **2**, 451–453.—A description of conventional grease-making plant for saponification in autoclaves under pressure. W. P.

179.* Y.P.F. Lubricating Oil for Aircraft Engines. **(Aircraft Lubricating Oil P. 444.)** Report by the Director General of Naval Air Force. *Bol. Inform. Petroleras*, Aug. 1939, XVI (180), 39–48.—Full report of the tests carried out with this lubricant in a Wright Cyclone 745-h.p. engine. The results were so satisfactory that the oil has been generally adopted in the Argentine navy for use in its aircraft. H. I. L.

180.* Characteristics of Lubricating Oils. Ing. A. S. Barcelo. *Bol. Inform. Petroleras.*, Aug. 1939, XVI (180), 34–37.—This is a dissertation on the necessary characteristics of lubricating oils, with special reference to the needs of automobiles, which was broadcast by the author at the request of the Y.P.F. H. I. L.

181.* Viscosity-Pressure Characteristics of Lubricating Oils. B. W. Thomas, W. R. Ham, and R. B. Dow. *Industr. Engng Chem.*, 1939, **31** (10), 1267.—Raffinate and

extract were prepared from a Pennsylvania 180 neutral oil by acetone extraction, and the viscosity of these and the unextracted oil determined over a pressure range of 1–2820 kg. per sq. cm. The temperatures chosen were 37·78°, 47·94°, 68·33°, and 98·89° C. A rotating cylinder viscometer was used. The results show that the extract has a considerably greater pressure coefficient than either the raffinate or the original oil. P. D.

182.* Effect of Pressure on Viscosity in Relation to Lubrication. J. W. Givens. *Industr. Engng Chem.*, 1939, **31** (9), 135.—The results on bearing temperature rise when using three oils under varying loads published by Everett (*S.A.E. Journal*, 1937, **41**, 531), are correlated by using a mean value of the viscosity under the pressure and temperature conditions of the bearing in calculating ZN/P. It is also shown that the temperature rise in the bearing is proportional to $(\alpha P)^2$, where α is the viscosity pressure coefficient for an oil. It is concluded that effects which might be attributed to "oiliness" are such as would be expected from hydrodynamic theory if the effect of pressure on viscosity is correctly allowed for. P. D.

183. Lubrication of Diesel Engines. H. O. Farmer. *Pwr. and Works Engr*, 1939, **34** (400), 401–403.—The functions of the lubricating oil and the varying conditions of temperature and pressure to which it is subjected are described. The importance of details such as external leaks and adequate crank-case ventilation is stressed. The purpose and significance of the usual laboratory tests, including viscosity, flash point, coke and oxidation tests, are described for the guidance of engineers who wish to purchase to specifications. Recent developments in the direction of solvent refining and the use of addition agents are indicated, and the treatment of the oil during or after use is briefly discussed. K. T. A.

184. Problems of Oil Engine Lubrication. K. Arter. *Pwr. and Works Engr*, 1939, **34** (400), 415–417.—Besides maintaining an adequate film between rubbing surfaces, diesel-engine lubricants have to seal the piston rings against gas leakage and play an important part in removing heat from the bearings and pistons. These arduous duties demand a high degree of stability, and a flat viscosity/temperature curve is usually desirable. It is important to maintain satisfactory lubrication of the piston rings and cylinder walls, at the high temperatures which prevail; even momentary failure may cause lasting damage through scuffing, and this, in turn, permits increased blow-by of hot gases. These gases contain sooty carbon, acidic, and other undesirable constituents. If they are able to pass the piston rings at an abnormal rate, an unsuitable oil will quickly break down, ultimately causing stuck rings.

The removal of contaminants by filtration or centrifuging is good practice; the usual methods of treating used oils are briefly discussed. Water may get into the oil by leakage from the cooling system or through condensation of blow-by gases. In conjunction with other contaminants water can be a prolific source of sludge; good crankcase ventilation and the avoidance of low operating temperatures are therefore important. Recent developments in refining methods and the use of addition agents are outlined, and the operator's problem of balancing lubricant quality against price is discussed. K. T. A.

Asphalt and Bitumen.

185.* Failure of Asphalt Surfacings and Adhesion of Binder and Stone. R. Ariano. *Le Strade*, 1939, **8**, 409–425.—The failures, such as cracking, loss of adhesion, and consequent infiltration of water, often experienced in asphalt surfacings subject to wide temperature variations are considered and the cause of difference in behaviour of surfacings on earth and concrete roads was investigated.

Laboratory findings, subsequently confirmed by actual practice, demonstrated that the concrete, which is permeable, can give rise in certain instances to the failures mentioned in the surface coating; it seems, however, that by a convenient treatment with road oil, this permeability can be at least partly reduced, if not entirely eliminated.

The various methods proposed to determine cohesion and adhesion are then described and it is pointed out that in general they do not correspond to the behaviour of the materials during actual use. Results of adhesion tests on stones made by the Experimental Road Institute are then described, and it is concluded that, unless subjected to the action of water, the adhesion between binder and stone may be even greater than between binder and binder. The importance of the quality of asphalt employed is stressed, and it is stated that results obtained with asphalt from asphaltic rocks are generally better than with the first-grade petroleum asphalt, and that adhesion is greater with increasing hardness for asphalts of the same source. The use of highly porous aggregates should be avoided, as they tend to bring the under-bottom water into contact with the protective coating. The influence of temperature is noted, and it is also pointed out that improvement of adhesion occurs with weathering. P. G.

186.* The Stability of Emulsions. Part I. Soap Stabilised Emulsions. A. King and L. N. Mukherjee. *J. Soc. chem. Ind.*, 1939, **58**, 243–249.—The instability of an emulsion is defined as the rate of decrease of its interfacial area with time, and the difference between this and sedimentation is pointed out. The efficiency of an emulsifying agent is a specific property, and hence comparisons can only be made with two given liquids and various emulsifying agents. The systems examined were kerosene–water and olive oil–water, and the size frequencies were observed after definite time intervals using various emulsifying agents in varying amounts; the emulsions were prepared in an homogenizer or by hand-shaking. In general the globules became coarser with time, and it was provisionally concluded that for homogenized emulsions particles larger than 7·5 μ coalesced to give free oil. For hand-shaken emulsions the particles are much coarser, a large number of particles being greater than 7·5 μ. The difference is considered to be due to the differing amounts of air entrained at the emulsion interface. As a quantitative basis of comparison, the decrease in the total area of interface per gram of oil after given times has been used, and found to decrease linearly with time. The reciprocal of this decrease has been defined as the emulsion stability. The formation of free oil alters the linear relationship, and hence it is advisable to take values before much free oil separates. Comparison of the stability of emulsions can also be made by means of the " time of half-break."

Soaps in general give very fine but relatively unstable emulsions. Sodium and potassium soaps have a very similar emulsifying effect, whilst ammonium soaps are definitely inferior. Oleates are the most efficient emulsifiers, potassium oleate being the best, and palmitates the least, both with kerosene and olive oil.

Finer and more stable homogenized emulsions were obtained when the soap was formed *in situ* than when added as an entity. The specific area of interface obtained with homogenized emulsions was about ten times that obtained by hand-shaking, and the ratio of stabilities about 1·8 : 1 on the average. The presence of calcium ions, hydrochloric acid, or heat accelerates the decrease in stability in all cases.

The paper concludes with experimental details of the preparation of soaps, emulsions, methods of sampling, and of size-frequency analysis. H. G. W.

187.* Emulsions in Industry. Part V. Asphaltic Bitumen Emulsions in Building and Road Construction. H. L. Bennister. *Chem. and Ind.*, 1939, **58**, 758–762.—The author points out that owing to the greater complexity of asphaltic bitumen compared with oils, and hence the complexity of the emulsions obtained, some difficulty is experienced in preparing emulsions of a given specification. The greater ease of handling when cold is a definite advantage of emulsions over other bituminous materials. Methods of manufacture by stirrer or colloid mill are discussed, and it is stated that the particle size usually ranges from 1 to 5 microns, with occasional particles up to 15 microns. The character of the dispersing agents used, which are alkaline bases ranging from sodium hydroxide to pyridine, and of the stabilizing agents, such as soaps, gums, sulphonated fats, etc., has a marked effect on the finished emulsion and on the bitumen obtained on breaking. More stable types of emulsion are obtained by the use of bentonite, etc., or the hydroxides of certain metals, and in general these are acid or neutral and stable to electrolytes, fillers, etc. Mixed emulsions are also used for certain purposes.

For road use emulsions must be stable on storage, yet " break " readily when spread

on the road. The use of sodium oxalate, fluoride, glycols, alcohols, etc., is stated to increase the storage stability, whilst the rate of breaking is controlled by the quantity of stabilizing agent used. The waterproofing of cement, concrete, and mortar by the addition of 20–30% of bituminous emulsion is mentioned, as well as the use of a lighter emulsified oil for dust-laying. By the addition of dyestuffs, pigments, and metallic powders are obtained bituminous emulsion paints, used mainly for waterproofing buildings, etc. Emulsions containing only 30% of bitumen are used in soil stabilization, particularly underground, and details of manufacture of such emulsions are given.

An outline of the methods of testing emulsions before use is given, and the difficulty of obtaining entirely satisfactory emulsions is mentioned. Properties generally examined include homogeneity, storage stability, viscosity, water miscibility, resistance to freezing, and rate of breaking in use. By distillation of the emulsion in iron stills the bitumen and dispersing agents used can be examined.

The author points out that "satisfactory all-round fulfilment of the exacting specifications with gradual modification and improvement of products is the keynote of the industry to-day rather than sudden development in specialized fields."

H. G. W.

188. Emulsified Asphalts. C. A. Downing. *Proc. Assoc. Asph. Paving Techn.*, 1939, 242–265.—In a paper presented at the 1935 annual meeting of the A.S.T.M., the author described a method of test intended to give information regarding the storage stability of bitumen emulsion in much shorter time than the A.S.T.M. 5-day settling test. The present paper includes a further description of the method, with minor modifications and results of tests on 373 samples of emulsion. The test consists in determining the difference in bitumen content of samples taken 1 cm., 2·5 cm., and 4·6 cm. below the surface of a mixture of 50 ml. emulsion and 350 ml. water, contained in a 400-ml. beaker, which has been allowed to stand for 2 hr. The bitumen content is determined by heating 1-gm. samples in a constant temperature oven at 163° C. for 2 hr. and re-weighing. It is stated that the relationship between the settlement test and the modified miscibility test was such that in 1937 the settlement test was replaced in specifications by a clause requiring that the maximum difference in bitumen content of the samples from the various depths should not exceed 4·1% for mixing emulsions. The author is of the opinion that this test, the cement mixing test, and the dehydration test are of greater value in anticipating the service behaviour of emulsion than any other tests. In connection with the cement mixing test it is stated that it is advisable to specify the surface area of the cement, and in future specifications a minimum of 1900 sq. cm. per gm. will be prescribed. A. O.

189. Blistering of Asphalt. A. W. Attwool. *Proc. Assoc. Asph. Paving Techn.*, 1939, 280–309.—An account is given of investigations which were undertaken several years ago in an attempt to determine the cause of blister formation in asphalt surfacings. In one case of extensive blistering in mastic asphalt, examination of the asphalt and aggregate, the concrete, and samples of the subsoil indicated that the materials were normal, and it was thought that the trouble may have been due to the formation of water vapour and possibly other gases from decomposition of coke breeze, used as a bed for the concrete, this causing pressure to be exerted upwards, and resulting in lifting of the surface in weak places when the asphalt softened in warm weather. In another case there were dozens of blisters, ranging up to 6 in. in diameter and about 1 in. in height, on the north side of the road, whilst the south side was free from blisters. Three blisters were removed and samples taken of the asphalt, the underlying concrete, subsoil, and gas from blisters. During removal of the blisters adhesion of the asphalt to the concrete was found not to be very strong in some places, and numerous beads of moisture were present under each blister. The asphalt was found to be normal, and the gas in the blisters consisted of air with a little water-vapour, whereas the gas evolved on heating the asphalt in the laboratory contained a high percentage of carbon dioxide and a relatively high proportion of unsaturated hydrocarbons. Gas evolved on heating the concrete more closely resembled the gas from the blisters, but differed with regard to carbon dioxide and hydrogen, whilst the gas from the soil contained an extremely high percentage of carbon dioxide. Examination

of the concrete and sub-soil showed the concrete to be good, but rather porous; the clay sub-soil contained clinker to which was attributed the carbon dioxide evolved on heating the soil. The results of investigation did not support the various theories concerning blister formation, and the author put forward the following explanation: Small "blows" which are produced through moisture, overheating, etc., during laying are sealed in the underside of the asphalt, and when the asphalt is softened by the sun, the trapped air expands and a small blister is formed. When the temperature falls, the asphalt hardens, the air contracts, and a subnormal pressure exists in the blister, with the result that air or moisture is drawn from the concrete. This process continues with alternate heat and cold, and the blister increases in size. Tests made in the laboratory showed that it was possible to lay a surface in such a way as to produce artificial blisters and then to relay the surface so that no blisters can be produced. It was concluded that if potential blisters are avoided in laying, it is impossible to produce blisters; potential blisters are more easily produced if the temperature of the mastic is unduly high, and sun temperatures as low as 45° C. will produce blisters if potential blisters exist under the mastic. These views received support from investigations by other workers. Subsequently, in order to determine whether the bitumen may have indirectly contributed to the tendency to blister, a co-operative investigation was made, samples of mastic from twenty-two streets laid by different contractors being examined. It was found that in most cases where the material was laid directly on the concrete blistering was evident, whereas when separated from the concrete no blistering had occurred. It is stated that of the asphalts in which Venezuelan bitumen was used as flux, 69% had blistered, and that this would seem to indicate some superiority of the Mexican bitumen flux. Analyses of the samples indicated no apparent relationship between bitumen content and blistering. All samples with hardness numbers over 22, blistered, whilst samples with lower hardness numbers were satisfactory. All gravel-gritted mixtures were satisfactory, but granite-gritted mixtures blistered. The relationship between hardness and blistering is believed to indicate that if there is a tendency to blister, it will occur more readily if the asphalt is soft. Surfacings were laid on concrete slabs, so that half of the slab was occupied by one of the asphalts fluxed with Venezuelan bitumen and half with one of the asphalts fluxed with Mexican bitumen. The sides of the slabs were sealed and the slab immersed to a depth of 4 in. in a water-bath and heated from above by means of an artificial sun. A slight blister appeared on the Venezuelan material in about 8 hr., and after further exposure blisters appeared on both sections of the slab, the blisters on the Venezuelan section being larger but less numerous than on the Mexican section. The asphalts were then relaid with a thin layer of sand upon the concrete, when it was impossible to produce a blister on either section. Tests on the two bitumens are said to show that the Mexican bitumen is more stable. Both materials were of the same penetration, but the Mexican bitumen had higher softening point, plasticity, and viscosity, and it is thought that the surface tension of the Mexican bitumen is higher and will cause that bitumen to adhere to the concrete more strongly. A. O.

190. Correlation of Physical Tests with Service Behaviour of Asphaltic Mixtures. J. S. Miller, H. P. Hayden, and R. Vokac. *Proc. Assoc. Asph. Paving Techn.*, 1939, 310–326.—In a previous paper details were given of an investigation which was undertaken for the purpose of correlating physical tests with service behaviour of asphalt surfacings. Examination was made of a number of pavements at least two years old representing (*a*) cracking type of surface, (*b*) sound type which had neither cracked nor shoved, and (*c*) shoving type. Classification of each pavement was made in the field by inspection of the surface and from service records. Information as to the type, source, and consistency of asphalt cement, gradation of aggregates, and box weights was obtained where possible, and samples were taken of each of the pavements. The present paper discusses the tabulated data concerning composition, density, voids, and characteristics of the original asphalt cement and of the bitumen recovered by the Abson method. It is pointed out that asphalt cements are believed to continue to harden during the life of a pavement, and that pavements which are satisfactory when laid may change to the cracking type as a result of hardening. The data indicate that type "*b*" Trinidad pavements are about three times the age of petroleum bitumen type "*b*" pavements, and that transition to the cracking type has taken twice as long in the case of Trinidad mixtures. Petroleum bitumen pavements which shoved but

had not required replacement served longer than the "*a*" and "*b*" types. No definite trend in aggregate grading was found to account for behaviour of the various types. In the petroleum bitumen pavements the average filler content increased from types "*a*" to "*c*," while the average bitumen content was similar for "*a*" and "*b*," but was 1% higher for "*c*," and it is concluded that cracking could only have been due to hardness of the petroleum bitumen. The average filler content of the Trinidad pavements was substantially the same, whilst bitumen content increased from "*a*" to "*c*," and cracking is attributed largely to deficiency of bitumen. Density and voids were determined both on the original pavement and on a sample of the mixture compressed at 325° F. with a load of 5000 lb./sq. in. The Trinidad "*a*" mixtures contained about 1·2% more filler and 0·7% less bitumen than the petroleum bitumen mixtures, but the voids were only 3·1% for Trinidad, as compared with 7·1%. Voids in the original pavement and in the recompressed mixture were similar for Trinidad mixures, whereas the petroleum bitumen mixtures were reduced from 7·1% to 4·3% on re-compression, showing that Trinidad mixtures were more readily compressed on the street. In the "*b*" pavements the voids in the Trinidad mixtures were not altered, and were only slightly reduced on re-compression in the petroleum bitumen mixtures. In the "*c*" type the original condition is disturbed by shoving and a decrease in voids occurs on re-compression. The average ductility of bitumen recovered from "*b*" type pavements was 40 cm. in the case of petroleum bitumen mixtures, as compared with 139 cm. for Trinidad. The consistency of the asphalt cement and of the recovered bitumen becomes harder with the change from the "*c*" to the "*a*" type, and other properties such as penetration and specific gravity change accordingly. Decrease in penetration of the bitumen recovered from "*a*" type Trinidad pavements is believed to be due to overheating in the mixer.

The average penetration of the bitumen from the "*b*" Trinidad mixtures was only 7 points below the original, and since the average age was 28 years, it is thought that the bitumen would have complied with most stringent specifications in its early life. The "*b*" petroleum bitumen mixtures show an average decrease in penetration of 22 points, and it is thought that these pavements, of which the average life is 9 years, will develop cracking within a few years. The average penetration of the bitumen recovered from "*c*" type Trinidad pavements was only 2 points below the original, whereas the petroleum bitumen pavements showed an average decrease of 16 points.

Although the penetration of the bitumen of Trinidad asphalt cement was about 20 points softer and average age of the pavements much greater, the percentage decreases in penetration was slightly lower for Trinidad than for petroleum bitumen pavements. In both cases the penetration range in the three types showed little overlap. The low limit for consistency of petroleum bitumen in type "*b*" pavements was about 24 penetration, which agrees with the mean of Hubbard's range for unsatisfactory performance, the questionable range for Trinidad is thought to be 30/40 penetration. The data are said to indicate that Trinidad bitumen will serve satisfactorily at softer consistencies than petroleum bitumen, and this is attributed to the stabilizing action of the natural filler. A. O.

191. Bituminous Road Materials. G. W. Eckert. *Proc. Assoc. Asph. Paving Techn.*, 1939, 327–386. This paper is a review of patent and periodical literature published in 1938. The patent literature covers preparation of asphaltic bitumen, use of solvents addition agents, emulsions, and bitumen-aggregate systems, whilst the subjects considered in the periodical literature include chemistry, physical properties, cut-backs, emulsions, tars, weathering, adhesion, admixtures, testing of bitumen-aggregate mixtures, surfacing, recovery of bitumen, and soil stabilization. A. O.

See also Abstract No. 169.

Special Products.

192. Coal and Lignite as Basis for Home Production of Solvents and Softeners. O. Horn. *Brennstofftechnik*, 1939, **20**, 349–352.—A detailed summary is given of all solvents, including synthetic petrols, spirits, and softeners, as well as synthetic fatty acids, produced in Germany from coal and lignites. The article deals with the production of these materials from coal *via* tar and benzol or phenol, from coal *via* calcium carbide and acetylene, and with hydrogenation of coals and lignites. E. W. S.

Detonation and Engines.

193.* Development of Anti-knock Motor Fuel. A. W. Trusty. *Petr. Engr*, Sept. 1939, **10** (13), 106.—The history of the development of the present-day methods of knock-testing are outlined. Investigation of knock-testing arose from the fact that the "knock" or detonation proved to be the most important factor limiting engine efficiency. Earlier tests were often contradictory, owing to the different conditions and standards used by various workers. The adoption of standard test equipment and precisely defined control has by to-day resulted in the evolution of reproducible methods. Nevertheless comprehensive tests to correlate road performance with laboratory ratings have shown that wide divergences are experienced with different cars, so that it is doubtful whether strict correlation with road performance in a laboratory test can be achieved. The adoption of *n*-heptane and *iso*-octane as primary standards has removed the confusion arising from the use of different standards. The high cost of these primary standards has, however, resulted in the adoption of carefully calibrated secondary reference fuels.

Recent changes in engine design show a considerable increase in efficiency. This was only made possible by a corresponding increase in the anti-knock quality of fuels. The factors affecting detonation are outlined, and the importance of the major ones, such as spark-timing, engine speed, and mixture strength, is discussed. R. J. E.

194. Knocking in the Otto Engine. H. Weinhart. *Luftfahrtforsch.*, 1939 (16), 74–78.—By comparing some observations in a comparatively long bomb in which an actual detonation is induced, with that in a single cylinder, it is possible to show that even with heaviest knocking in the Otto engine no detonation proper is taking place, but a very quick combustion. The ionization method is used for rating the combustion speed. E. W. S.

195.* Engine Flame Researches. T. A. Boyd. *J. Soc. Aut. Engrs*, 1939, **45** (4), 421–432.—This paper is a review of research on engine combustion pursued by General Motors Research Laboratories over many years. Single-cylinder studies were commenced with the Midgley optical indicator, which threw some light on the nature of knock. For the quantitative indication of knock the bouncing-pin was developed. Next, the progress of the combustion reaction was traced by means of a gas-sampling valve; it was shown that the progress of the reaction across the combustion space was continuous and the reaction rate accelerated as engine speed increased. During knocking combustion the gas farthest removed from the plug contained aldehydes, chiefly formaldehyde.

To obtain further information on the nature of detonation, photographs of the flame-front were taken through a quartz slit running the length of the chamber. Under non-detonating conditions the flame advanced at a fairly uniform rate; with the onset of knocking the last part of the charge appeared to burn instantaneously, coinciding with a steep rise in the pressure diagram. During knocking combustion surges or pressure waves are apparent both in flame photographs and indicator diagrams. It has been shown that there is a one-to-one ratio between the frequency of these waves and that of the audible sound of knock. Measurement of the energy radiated during combustion has shown that it is a maximum at the mixture ratio corresponding to maximum power; it is increased when detonation occurs.

The next development was the spectroscopic study of the light passing through the window during combustion. The flame proved to be similar in composition to the inner cone of a gasoline torch, both showing the characteristic bands of CH and C_2. However, these bands were absent from the region *behind* the flame, called the afterglow, indicating that combustion was completed within the flame-front. Ultra-violet spectra revealed the presence of OH radicals both in the flame and the afterglow; bands corresponding to the HCO combination were identified in the flame, but not in the afterglow. When knock was present the CH and C_2 bands in the flame-front were reduced in intensity, and formaldehyde was one of the oxidation products formed ahead of the flame.

Flame temperatures, measured by the sodium–line-reversal method, were between 3700° F. and 4200° F. (4550° F. when knock occurred).

To obtain more detailed information regarding the flame-front, the quartz slit was

replaced by a thick plate of fused quartz covering the entire cylinder head, and a special camera enabled thirty consecutive pictures to be taken of one combustion. These clearly showed the uncontrolled nature of combustion in the detonating portion of the charge. Analysis of the flame-pictures in conjunction with accurate pressure diagrams yielded a definite relationship between fraction of the volume inflamed and mass of charge burned. The influence upon combustion rate of changes in ignition timing, air/fuel ratio and throttle opening is illustrated graphically. As a result of these researches it is now possible to calculate the volume of gas inflamed and mass burned at any instant, without the need for flame pictures, provided that accurate pressure cards are available and that allowance is made for piston motion.

K. T. A.

196. Alternative Fuel Engines. Anon. *Pwr. and Works Engr*, 1939, **34** (400), 413–414.—Unlike the gasoline/kerosine unit, the true alternative fuel engine should be able to use either of two fuels to equal advantage. British manufacturers have been developing engines which will run on town or producer gas as well as diesel oil; the change-over can be accomplished while the engine is running. When operating on gas, a small pilot charge of oil is still injected for ignition purposes, and the proportion of oil to gas (measured on a B.Th.U. basis) can be varied between, say, 4% and 100%. Two typical engines described and illustrated are the 130 B.h.p. Crossley and the National. Test results show that, on the basis of B.Th.U./B.h.p./hr., fuel consumption is approximately the same with liquid and gaseous fuel. K. T .A.

197.* Piston Ring Blow-by on High Speed Petrol Engines. C. G. Williams and H. A. Young. *J. Instn Aut. Engrs*, 1939, **7** (9), 30–65.—Three engines have been employed in the investigation of blow-by and several variables have been studied, particular attention being given to blow-by at high speeds. The engines used were :—

(1) An overhead valve single-cylinder water-cooled engine of 500-c.c. capacity, having a maximum speed of 4000 r.p.m.;
(2) A 500-c.c. air-cooled motor-cycle engine of racing type with a maximum speed of 2000 r.p.m.; and
(3) A four-cylinder engine of 1267-c.c. capacity operating up to 5500 r.p.m.

Special precautions were taken to seal the crank-cases from air leakage, the efficiency of the sealing arrangements being checked by noting the rate of pressure drop after the crank-case pressure had been increased to 10 in. of water. The crank-cases were connected to an expansion tank to provide adequate damping of fluctuating pressures, this tank being connected to a calibrated gasometer balanced so as to impose negligible back pressure. The mean radial pressure of piston rings used in the experiments was measured by the flexible band method, in which a band is wrapped round the ring and force applied until the gap is closed.

The variables studied included side clearance; radial pressure; cylinder bore distortion; rate of oilflow; piston-ring width, ring gap; clearance behind rings; B.M.E.P.; number of rings; oil viscosity; and spark advance, and, in addition, the effects of bevelled and wedge-shaped rings were investigated.

The authors' main conclusions show that beneficial results are obtained by increasing the piston-ring radial pressure or engine load, and by reducing ring-side clearance, ring width, or number of rings; and by retarding the spark. These remedies, however, necessitate some compromise. Blow-by was adversely affected by poor cylinder bore condition and insufficient running-in. Taper-turned rings gave high initial blow-by, but reached stability more quickly than plain rings. No effect was noted due to varying oil viscosity or quantity of oil supplied, and no beneficial effect was produced by the use of wedge-shaped rings.

A theory of ring flutter is submitted. It is suggested that at sufficiently high speeds the piston ring moves from the lower to the upper side of the ring groove just after top dead centre, because of frictional drag and inertia. This change in ring position releases pressure at the back of the ring, which is then suddenly subjected to gas pressure from the ring face, which may occur with sufficient violence to cause fracture.

C. H. S.

198.* Air and Air Filters for Diesel Engines. D. Adams. *Petr. Engr*, Sept. 1939, **10** (13), 47.—The general control of air and air filtration for diesel engines is outlined. Filters offered for this purpose are all based on the principle of providing an oil surface on which the air impinges so that dust particles are caught and held by the oil. Usually air-intake filters are placed outside the building, and the design and construction of the intake pipe, together with the provision of suitable housing, are discussed and illustrated. The quantitative air requirements of typical diesel engines are given and the attraction of supercharging exemplified. R. J. E.

199.* Bore Wear from the Viewpoint of Materials.—P. S. Lane. *J. Soc. Aut. Engrs.*, 1939, **45** (4), 413–420.—The nature of wear between various combinations of ring and bore materials has been studied by means of a brake-shoe type of machine, normally run dry. On a weight-loss basis piston-ring irons are not the "best wearing" irons but they have the desirable faculty of freedom from scuffing action. The ability to readily release wear products without surface mutilation is probably at least as important as low weight loss. Gray cast-iron structures which show low weight loss are subject to scuffing and often cause high wear of mating surfaces, even though the latter are much harder.

Variations in the structure and wear of automotive cylinder castings are illustrated, and the balancing of wear through hardness and structural relations is discussed. Relative wear values for various cylinder sleeve materials are presented.

K. T. A.

200. Mixture Strength and Volatility. L. A. Peletier. J. L. Tops, and W. J. Baron van Heeckeren. *Aircr. Engng*, Nov. 1939, XI (129), 407–410.—Tests were carried out on a modern 9-cylinder radial, air-cooled aero-engine supercharged by centrifugal blower to ascertain the effect of fuel volatility on the uniformity of mixture distribution. The tests were made at intake air temperatures of about 15° C. and 50° C. and at lean and rich mixture strengths with fuel–air ratios of approximately 0·073 and 0·096, respectively. The volatility of the seven fuels used as characterized by their 90% distillation points ranged from 101° to 185° C. Nine Cambridge mixture strength indicators were used for measuring the strength of the mixture fed to each individual cylinder.

Contrary to expectations, at low intake air temperature (about 15° C.) with both lean and rich mixtures distribution became more uniform with decreasing volatility. At the higher air intake temperature (about 55° C.) distribution became less uniform with decreasing volatility up to a 90% point of 152° C. The fuel having a 90% point of 185° C., however, then showed the most uniform distribution of the fuels tested. At the higher intake air temperature and at rich mixture distribution appeared to be practically independent of fuel volatility. No significant difference in the evenness of distribution was observed when certain of the tests were repeated with another make of carburettor.

Following up a tentative explanation for certain of their findings, the authors suggest that there would seem to be two conditions at which an ideal distribution could be obtained :—

(*a*) when complete immediate evaporation takes place in the carburettor, and the impeller is being fed with a homogeneous vapour–air mixture;

(*b*) when an evaporation takes place between the carburettor and the impeller, the latter serving as distributing agent for the liquid.

The deflection of the mixture between carburettor and impeller is, in the authors opinion, the main cause of distribution irregularities when neither of the ideal cases obtains. E. F. C.

See also Abstracts Nos. 168, 183, and 184.

Coal and Shale.

201.* Colloidal Dispersion of Coal. J. M. Pertiewa. *IIme Congrès mond. Pétrole*, 1937, **2**, 213–216.—The dispersion of coal in various liquids is studied by measuring the heat of wetting of pulverized coal before and after removal of adsorbed gases.

The important part played by adsorbed gas films is demonstrated, the gas-free coal being more readily and more completed wetted.

The quantity of hydrogen adsorbed by a coal at 100 atmos. pressure and at 16° C. and 100° C. is determined. Although when gas-free coal is placed in contact with liquids such as fuel oil, anthracene oil, molten paraffin wax, greater wetting and greater dispersions are achieved at atmospheric pressure, yet if such a system is hydrogenated at 200–225 atmospheres and 450° C., the amount of coal transformed into liquid and gaseous products diminishes and the rate of adsorption of hydrogen increases as compared with a similar system containing coal which has not been freed from adsorbed gases. W. P.

202.* Methylation of Inferior Fuels to Produce Aromatics. F. Michot-Dupont. *II me Congrès mond. Pétrole*, 1937, **2**, 197–212.—A process is described whereby materials such as lignite, peat, schist, cannel-coal, etc., are distilled at low temperatures in the presence of alkali or alkaline-earth salts of fatty acids (calcium acetate), the system being made alkaline by sodium carbonate and activated by iron or iron oxide.

The constitution of the products is shown and the mechanism of the reactions discussed. Commercial production and utilization of the products are described.

It is claimed that the process gives a high yield of primary tars; eliminates phenols with the production of substituted aromatic hydrocarbons (especially toluene and xylenes); reduces the sulphur content of the distillates (the sulphur being recovered from the gases); yields heavy oils which can be readily cracked or hydrogenated, and gives a residual coke of good quality. W. P.

203.* Fushan Shale Oil. K. Ishibashi. *II me Congrès mond. Pétrole*, 1937, **2**, 183–196.—A comprehensive account of the refining of Fushan shale oil and of the properties of the crude oil and the various fractions derived from it. W. P.

Economics and Statistics.

204.* Declaration of Neutrality of the Argentine Republic—Decree. Anon. *Bol. Inform. Petroleras*, Sept. 1939, XVI (181), 123–127.—Declaration of Neutrality of the Argentine Republic in respect to the state of war existing between France, Great Britain, Poland, and Germany. This is followed by the text of a new law No. 12,591, which is to be promulgated without delay in order to make effective control of prices, etc., in view of the existing emergency. H. I. L.

205.* Report and Balance Sheet of the Y.P.F. for 1938. Anon. *Bol. Inform. Petroleras*, Sept. 1939, XVI (181), 1–110.—The report is fully detailed and contains much matter of interest. There are numerous graphs, especially those showing production, which repay examination. Attention is directed to the diagram on page 110 showing the rapid development in Mendoza during the period 1938–39. H. I. L.

206.* Uruguay—Tax on Refined Fuel Oils.—Decree. Anon. *Bol. Inform. Petroleras*, Aug. 1939, XVI (180), 59.—This decree regulates the quantities of fuel which may be imported free and those subject to taxation. The figures for the different quotas will be submitted to the Executive in the first fortnight of June and December. The Decree appears to be dated at Montevideo, 18th August, 1939. H. I. L.

207.* World Legislation affecting Petroleum. Anon. *Bol. Inform. Petroleras*, Aug. 1939, XVI (180), 53–55.—This is a continuation of a reference index to various laws affecting the petroleum industry, in all countries, contained in No. 174 and subsequent numbers. The present index covers Irak, Italy, Japan, and Liberia. H. I. L.

BOOK REVIEW

Uses and Applications of Chemicals and Related Materials. Compiled and Edited by Thomas C. Gregory. 8vo. Pp. vi + 665. Reinhold Publishing Corporation, New York, 1939. Price 60s.

A series of surveys under the title "Where You Can Sell," subsequently changed to "Industrial Uses of Chemicals and Related Materials," has been appearing in the *Oil, Paint and Drug Reporter* since 1922. These surveys were conducted by Ismar Ginsburg until his death in 1933, when they were continued by Thomas C. Gregory. Under the editorship of Mr. Gregory, the material collected in these surveys has been incorporated in book form.

The book deals with the uses, potential applications and sales possibilities of 5167 substances, including petroleum products, greases, animal and vegetable oils, and waxes. The products are dealt with in strict alphabetical order under their common rather than chemical name, and hence the book will be useful to non-technical readers. The name of each item is given not only in all variants commonly encountered in English, but also in the more important foreign languages, while in connection with the uses of many of the substances listed patent references are given. An appendix of nine pages devoted to synonyms and cross-references is also included.

Very comprehensive lists on the uses of many petroleum products are given—for example, two pages are devoted to the use of paraffin wax in thirty-six main connections, including even such minor uses as paraffin wax bath medical treatments. The references to several petroleum products could, however, have been improved, *iso*-octane, for instance, being described as a "compounding agent for aviation gasoline."

The uses of a very large number and variety of substances valuable in petroleum technology have been adequately described in detail, with many patent references. The employment of acetyldiphenylamine as a coal carbonization spent stabilizer and the condensation of *cyclo*hexylphenyl ether with halogenated derivatives of aliphatic hydrocarbons to produce pour-point depressors are typical examples selected at random. The use of substances as catalysts in petroleum refining operations has not been overlooked, although the details pertaining to aluminium chloride in this connection might have been more comprehensive; nevertheless the main uses have been well covered.

The work is undoubtedly a reference book of considerable value.

T. G. HUNTER.

PUBLICATIONS RECEIVED

The Canadian Mineral Industry in 1938. Reviews by the Staff of the Bureau of Mines. Pp. iv + 102. Canada Department of Mines and Resources, Mines and Geology Branch. No. 804. Price 25 cents.

The report is divided into three sections: metals, industrial minerals and fuels, the latter containing an account of Canada's resources of coal, coke, natural gas, oil shale, peat and petroleum. Close to 97% of the total Canadian output of crude petroleum is now being obtained from the Turner Valley field in Alberta. The total production of petroleum in 1938 amounted to 6,956,229 brls. as compared with 2,943,750 brls. in 1937.

A Printing Method of Recording Road Surface Texture. By J. S. Wilson. Road Research Bulletin. No. 3. Pp. 6. Plates 11. H.M. Stationery Office. Price 9*d*.

This pamphlet describes a simple method which has been developed at the Road Research Laboratory, by means of which dangerous surfaces may be detected. A few square inches of the road to be examined are flicked with a cloth to remove dust and then carefully inked over either with an ordinary half-tone black printing ink diluted with paraffin or with a water letter-press ink. A clean rubber roller is run over the inked area and the impression on the roller transferred to a piece of paper. The stones depicted in the prints appear as if in relief, the shading of the ink giving a stereoscopic effect. The method lends itself to the study of the texture changes which a road carpet undergoes during its life, and the progress towards failure of the carpet by becoming slippery or by its disintegration is clearly shown.

Methods for the Detection of Toxic Gases in Industry. Carbon Disulphide Vapour. Department of Scientific and Industrial Research. Leaflet No. 6. Pp. 8. H.M. Stationery Office, 1939. Price 3*d*.

This pamphlet describes the properties, occurrence, poisonous effects and method of detection of carbon bisulphide vapour. The standard method adopted for the detection of low concentrations of the vapour in industry depends on its interaction with diethylamine and copper acetate, to produce a coloured compound, copper diethyldithiocarbamate.

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Geology.

208.* Correlation of Surface and Subsurface Formations in Two Typical Sections of the Gulf Coast of Texas. A. Deussen and K. D. Owen. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1603–1634.—From data now available, two sections of the Gulf Coast have been prepared giving details of the strata to a depth of 12,000 ft. The first, or East section, extends from Fayette Co. to Matagorda Co., and the second, or West section, from McMullen Co. to Nueces.

East Section.—The lowermost beds of this section belong to the Yegua formation, at the top being the Cockfield member. The Yegua is primarily a continental deposit with sands, peats, and clays of lake origin. These deposits, however, grade downdip into a series of shales, clays, and sands of marine origin. Indicative of marine conditions is the presence of *Discorbis yeguaensis* which occurs in a well section at the top of the Yegua at a depth of approximately 3500 ft.

Above the Yegua follows the Jackson formation, which consists mainly of sands and sandstones with interbedded clays and shales. Casts of marine fossils occur in the sandstones. *Textularia hockleyensis* is present in all the well sections with the exception of the well nearest the outcrop, this occupying a definite and persistent plane in the formation 200 ft. below the top.

Overlying unconformably the Jackson occur Oligocene sediments made up of the Catahoula (sands, clays, fossil wood, and volcanic ash). This is overlain, also unconformably, by the Oakville sandstone, a formation containing vertebrate fossils of Miocene age. Between these two formations there is encountered at depth a wedge-shaped deposit consisting of a marine shale and a sandy series ("Frio Sand"), followed by another bed of shale, the Vicksburg.

The remaining and uppermost sediments comprise Post-Oligocene beds, represented by the Fleming series, and composed of clays and shales deposited in lakes and fresh-water lagoons.

West Section.—The same depositional sequence is recorded here as in the East Section. Certain differences in thickness and positions, however, are noted. Only the western attenuated edge of the shale wedge occurs, and there is no thickness of this shale comparable with that of the East section. Its corresponding thickness in the West section is probably farther in the basin and beyond the present coast-line. The sands below the shale (the so-called subsurface "Frio") reach a much greater thickness in this area as compared with that of the East section, and, moreover, they crop out at the surface between the Jackson and Catahoula.

Though the correlation of the Frio and Catahoula has for long been a debatable question of Gulf Coast geology, the authors state that evidence now points to the surface Frio as the outcrop time equivalent of the Vicksburg, both formations having been deposited under different conditions, the Frio in salt-water bays, and the Vicksburg in the open sea. It also seems that the Catahoula is probably the surface time equivalent of the marine Oligocene group, including the lower sands (subsurface "Frio"), the intermediate marine shale wedge, and the overlying sand series.

Finally, it appears that in the subsurface there are at least four definite stratigraphic units which can be mapped by the usual methods of subsurface mapping, now unnamed or loosely or improperly named. G. S. S.

209.* Amelia Oil-field, Jefferson County, Texas. E. J. Hamner. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1635–1665.—This field was discovered in 1936, and is situated within the salt-dome province of the Gulf Coast in Jefferson County.

Stratigraphically, the following formations and groups are present: Pleistocene (Beaumont clay), Pleistocene and Pliocene (Lissie–Citronelle group), Pliocene and Miocene (Lagarto clay), Miocene (Oakville–Catahoula), Oligocene (*Discorbis*, *Heterostegina*, *Marginulina* zones, and the Frio formation). The Frio is at least 1800 ft. thick, and is the deepest formation yet penetrated at Amelia. It is made up of numerous beds of porous grey sands of varying texture. Nine distinct sand members are recognized, ranging from 25 to 475 ft. thick; these, with the exception of the top member, are fairly continuous and regular across the entire field. The Langham sand, the sixth member of the series, is the producing zone from 6694 to 6785 ft., and is the thickest (425 to 475 ft.) and best-developed sand-body of the group. An important feature of all the sands is their content of volcanic ash.

Structurally, the Amelia field is an elliptical flat dome adjacent to a big fault. The long axis of the structure trends north-east and south-west although the field is fairly symmetrical, the short axis of the dome is rather closer to the south-west end of the producing area. It is one of the first examples of an exceptional occurrence of production in the Gulf Coast, wherein the accumulation of oil lies on the downthrown side of the big fault rather than on the upthrown side.

The proved area of the field is 1180 acres, and to Jan. 1, 1939, the field has produced 2,644,642 brls. of oil from 114 wells, giving an average of 2168 brls. per acre. The Mary Langham No. 1 is the oldest producing well, and has yielded 77,000 brls., with prospects of good future production.

Concluding sections of this paper deal with the development of the field, in particular with well-completion problems and methods. A new method of completing low gas-oil wells by cement squeezing was introduced at Amelia with very successful results, and it is now used in all doubtful wells before original well completion. A description of the method is given with a sketch showing how the squeeze job is carried out.

G. S. S.

210.* Standard Permian Section of North America. J. E. Adams *et al.* *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1673–1681.—The authors advocate the classification of the American Permian as a system of four series. These, in ascending order, are: the Wolfcamp series, Leonard series, Guadalupe series, and Ochoa series. This classification is based on the thick and nearly continuous section exposed in and immediately adjacent to the Delaware basin.

Wolfcamp Series.—This, the lowest division, includes the oldest Permian rocks of the Glass Mountains region, which here consists of about 600 ft. of limestones, conglomerates, and shales.

Leonard Series.—The second division comprises beds formerly assigned to the Leonard formation, which at the type locality (south face of the Glass Mountains) is more than 1800 ft., and consists of limestones and dark siliceous shales. It rests unconformably on the Wolfcamp.

Guadalupe Series.—This series comprises beds that have been classed as the Guadalupe group. At the type locality, the south end of the Guadalupe Mountains, the series is 4100 ft. thick, made up of 2300 ft. of sandstones overlain by 1800 ft. of (Capitan) limestone. In the Delaware basin the Guadalupe is represented by a sandstone facies —the Delaware Mountain sandstone, 3000–3500 ft. thick.

Ochoa Series.—This, the top division, is designed to include all upper Permian sediments of post-Guadalupe age. They consist mainly of evaporites having a thickness of considerably over 4000 ft. Four distinct subdivisions are recognized.

A brief reference is made to a suggested correlation of these series with beds in other areas beyond the limits of the Delaware basin. G. S. S.

211.* Subsurface Cross-section of Permian from Texas to Nebraska. C. L. Mohr. *Bull. Amer. Ass. Petrol. Geol.*, 1939, **23**, 1694–1711.—This paper has for its object the presentation of the regional stratigraphy of the "Blaine" and older Permian beds. In illustration of this, sample logs have been selected from twenty wells for a cross-section from Texas to Nebraska. The locations of the wells are shown on an index map. The section is not carried to the surface, but the supposed surface correlations and the nomenclature are discussed. As a standard for reference, the marine Permian section of the Glass Mountains is utilized, which is 150 miles south-west of the south end of the cross-section.

The principal divisions of the Permian represented are the Wolfcamp, Leonard, and the lower part of the Word of the Glass Mountain section.

Palæontological evidence shows that several separate and distinct faunas are related to the correlation and classification of the Permian, both in wells and on the outcrops. These faunas may be designated in ascending order as the Shawnee (or Graham), Wabaunsee (or Thrifty), Wolfcamp, Leonard, lower and upper Word, Capitan, Custer (?Permian), and Moenkopi (Lower Trias). These zones are nearly all bounded by regional disconformities which are fundamental in the scheme of the present cross-section.

Two major disconformities can be followed for the whole distance, one at the base of the Wolfcamp and the other at the base of the Leonard. A regional unconformity

occurs between the Dog Creek shale and the overlying Custer sandstones, and, in some wells east of the cross-section, the base of the Custer rests on the base of the Blaine.

The unconformity at the base of the Wolfcamp is correlated with the middle of the Harpersville in Central Texas, the base of the Wanette in Southern Oklahoma, and the base of the Admire in Kansas and Nebraska. The Leonard–Wolfcamp disconformity probably lies just below the Elm Creek limestone in Central Texas, at the top of the Wanette in Central Oklahoma, and just below the Herington limestone in Kansas and Nebraska.

Figures of cross-sections of the Permian from Texas to Nebraska and from Texas to Oklahoma are furnished, together with a regional correlation chart. G. S. S.

212.* Oil Occurrences in South-West Lancashire. F. W. Cope. *Bull. Geol. Surv. Gt. Brit.*, No. 2, 1939, 18–25.—During a re-survey of the Formby District (S.W. Lancs.) seepages of oil were found in, and close to, Downholland Moss Lane, about a mile east of Formby. Indications of oil were also noticed at Barton Moss and Flea Moss, about two miles east and south of Formby, respectively.

At Thirty Acre Lane, close to the junction of Downholland Moss Lane, the occurrence of the oil is most striking, in that it is an active seepage. Preliminary examination of neighbouring drainage ditches cut in peat led the author to suspect that the oil originated in the peat. Later, an auger was used to investigate the occurrence, and sampling was carried out to a depth of about 16 ft. The section showed alternating beds of peat and silty clay, the peat containing much oil. During augering a good deal of gas was given off, which readily ignited.

A series of laboratory tests made by the Anglo-American Oil Co. shows the oil to have a specific gravity at 60° F. of 0·8885 and a low saponification value, the latter probably indicating a mineral origin. Examination of oil extracted from a peat sample taken near this section, however, appeared to be of vegetable origin. Thus, two types of oil were detected.

From other localities in the Downholland Moss oily peat and drops of oil were seen in ditches on either side of the Lane.

About a third of a mile to the north a shaft was sunk to a depth of 22 ft. in the bank of Downholland Brook and a similar section to that at Thirty Acre Lane was revealed. Oil was plentiful in the upper peat bed and also in the underlying silty clay. Considerable volumes of gas were liberated, and 7–8 gals. of oil accumulated in the shaft during one night.

Conclusions strongly favour a deep source for the oil. (The type obtained from the peat probably originated from a small quantity of oil-producing algae present in this material.) It is tentatively suggested that most of the oil may be derived from a buried Carboniferous structure beneath the Trias, and that it reaches the surface along the Hillhouse Fault. Little is known, however, of the thickness of the Trias in this area, and there is no evidence as to the character of the underlying Carboniferous. Further details of these rocks and more definite information regarding the South-West Lancashire oil occurrence will doubtless be available when exploratory boreholes are sunk in the Formby area.

At the end of the paper a biological report on the peat is given by Dr. K. B. Blackburn. G. S. S.

213.* Exploratory Boreholes. L. Migaux. *Bull. Ass. franç. Tech. Pétrol.*, 1.7.39 (50), 5–34.—An exploratory well must give the fullest possible information on stratigraphy, structure, and the nature and content of the permeable horizons. Rotary drilling is now used almost exclusively for this purpose, and the tendency is for drilling depths to increase and equipment to become heavier. Stratigraphical evidence is obtained from fossils, generally micro-organisms which require very detailed study, lithology, and the physical properties of the rocks (elasticity, electrical, etc.). Evidence obtained from the mud flush is very uncertain, especially as regards information on depth, and mechanical coring is preferable. Even this, however, is not perfect, since the core recovery is only 65–90% and the parts lost are the more porous and friable rocks which actually are the most interesting. A record of drilling speeds is useful in some areas. Electrical coring is almost universally used, and this, in conjunction with the above methods and side-wall sampling, will give sufficient information.

Structural evidence may be obtained from cores, although allowance must be made for deviation of the bore-hole from the vertical. This deviation may be measured, but the orientation of a mechanical core is still unknown. Hence one is dependent finally on some method such as the Schlumberger dip meter or by magnetic measurements on the core itself.

The presence and position of permeable horizons are given by electrical coring. The simplest method of testing those horizons would be to take side-wall samples after drilling was complete. At present, however, it is general practice to core mechanically in zones thought to be interesting. Mud flush samples and the electrical log assist in selecting such zones. Examination of these cores will indicate the type of fluid present in the permeable beds, but production tests are necessary to get full details of their probable value. Production tests may be carried out in various ways, but the best methods are those which test individual horizons. For this purpose a formation tester may be used, or tubing may be cemented at the base of the zone to be tested and then perforated at regular intervals above, tests being made after each perforation and the holes re-cemented before the next perforation is made. S. E. C.

214.* Discoveries Incite Vigorous Exploring on Four Mississippi Fronts. G. Weber. *Oil Gas J.*, 2.11.39, **38** (25), 13–15.—Interest in Mississippi is concentrated on four fronts—Tinsley field, Yazoo County; Vicksburg–Jackson district; Mississippi Sound; north-east Mississippi (including north-west Alabama). Over 1,530,000 acres were under lease prior to the Tinsley discovery.

The Tinsley field has shown a second oil zone under the discovery zone. Wells have been completed south and north-east of the discovery well, and a well to the north missed the Woodruff sand, but cored a good oil section in the deeper Eutaw formation at 2900 ft. Coring below 5040 ft. gave no other shows.

On the Vicksburg–Jackson trend the Glass dome and Blakely prospect of Warren County and the Sartartia structure near Tinsley are of interest. This area has subsurface formations similar to those of North Louisiana and Arkansas, and is somewhat faulted.

Ten gravity-meter, ten seismic reflection, two magnetometer parties, and one soil analysis party are at work in Mississippi. G. D. H.

215.* Nebraska Added to List of Oil-producing States. D. Dalrymple. *Oil Gas J.*, 9.11.39, **38** (26), 9, 10.—Commercial oil has been found in the Forest City basin of South-east Nebraska. The productive Hunton lime was met at 2288 ft. Production is estimated at 75–200 brl./day of 30° oil. The oil shows very little gas. The well-site was chosen after seismic work. In 1937 a well drilled 10 ml. to the west found some oil showings, but it was not possible to shut off the water. This test found the Mississippian, Silurian, and Devonian over the Viola relatively thin. Other wildcats have had oil showings. G. D. H.

216.* More Tests Follow Strike in Nebraska. D. Dalrymple. *Oil Gas J.*, 17.11.39, **38** (27), 89.—The bulk of drilling activity in the Falls City basin is in the Missouri sector. Several dry holes have been completed, but some new gas areas have been reported. Operations are also expected to increase in North-east Kansas following the Falls City strike. The Falls City discovery well found the Hunton lime at 2276 ft., oil at 2279 ft., and was bottomed at 2282 ft. On deepening to 2287 ft. more oil saturation was found. G. D. H.

217.* Wildcats, Oil Shows Accelerate Interest in Mississippi. Anon. *Oil Gas J.*, 17.11.39, **38** (27), 92.—Activity is centred on the Vicksburg–Jackson area, the interest being shared by the North-west Alabama basin which extends into North-east Mississippi. Oil seepages have been reported in Wilkinson County, and oil and gas shows in wildcats in Itawamba and Kempen Counties.

The Tinsley field is giving 325 brl./day. A sand at 5493–5508 ft. on the northern edge of the field has given salt water instead of being the hoped-for third oil sand. The Eutaw at 4865–4877 ft. has shown oil and is below the Selma section, which is producing in the present three wells.

In North-east Mississippi a test has reported a showing of oil or gas at 560–570 ft. in hard lime. G. D. H.

218.* Development of Two New Producing Zones Faces Salem, Illinois, Operators. H. F. Simons. *Oil Gas J.*, 23.11.39, **38** (28), 8, 9, 98.—Prolific production has been obtained in a deep Devonian test at the northern end of the Salem field. This is the fourth oil zone tapped since the field's discovery, and the presence of a fifth major producing zone is indicated by the efforts to recomplete in the St. Louis lime two former McClosky producers.

The recent Sandoval, Bartelso, and Salem discoveries in the Devonian have encouraged search for this horizon elsewhere, and tests have been started in the Centralia townsite and North Aden pools. Between the McClosky and the Devonian pay is an almost complete lime section with few shale zones. This will increase drilling difficulties. The Devonian lime is very porous and highly permeable.

McClosky wells decline slowly to a certain point while flowing and then suddenly cease to flow. On turning over to pumping they yield but a small percentage of their flowing production. G. D. H.

219.* Continental No. 1 Proctor is the Deepest Test in Mid-Continent Area to Date. Anon. *Oil Gas J.*, 23.11.39, **38** (28), 10, 11.—The well was taken to 14,479 ft. without any serious difficulties, but a series of fishing jobs ensued, and finally, at a total depth of 14,582 ft., it was decided to go back to test upper formations, amongst which a gas-bearing zone at 10,898 ft. was of special interest. This well was intended primarily to give information on the central part of the Anadarko basin of Western Oklahoma. It has shown that the thickness of Pennsylvanian beds in this basin is greater than was expected by most geologists. It has also revealed the value of diesel-electric equipment for deep drilling. G. D. H.

220.* Mississippi Play is Extending Throughout the State. G. Weber. *Oil Gas J.*, 23.11.39, **38** (28), 25.—It is estimated that 5,000,000 acres are now under lease in Mississippi, almost twice the area leased before the Tinsley discovery. In Clarke County in 1931 a well showed heavy oil in the Eutaw at 3692–3700 ft. before being abandoned at 4775 ft. A new test is to be drilled near this. Other tests are projected or under way in Attala, Copiah, Harrison, Hinds, Issequena, Itawamba, Lamar, Monroe, Pike, Prentiss, Simpson, and Yazoo counties.

In the Tinsley field a well on the west side has failed to find the Selma chalk, but is coring in the Eutaw section. A well in the north is coring below 6000 ft. without having found any shows. G. D. H.

221.* Mississippi is Experiencing a Real Oil Boom. B. Mills. *Oil Wkly*, 13.11.39, **95** (10), 42–53.—A ten-year search in Mississippi has revealed only one oil-field. The present boom is centred on the Tinsley discovery in Yazoo County. This involves Cretaceous beds, but the Palæozoic area in the north of the State also offers distinct possibilities at reasonable depths. The Amory gas-field is in the latter area. The southern part of Mississippi offers promise as a salt dome district, and the Cretaceous is at reasonable depths all the way to the coast. However, it is not present over all the State, and it is at greater depths in the west and south-west.

The Hartselle sandstone of the Upper Mississippian is perhaps the primary Palæozoic objective, for it has asphalt and oil along its outcrops in North Alabama. Many structures have been mapped, and gas has been developed at Fayette (Alabama) and Amory (Mississippi). There have been many oil-shows, but no commercial production.

Igneous intrusions are common in the Cretaceous belt centred near Yazoo City. The Tinsley dome has an uplift of 125 ft. at the surface and about 600 ft. of closure on top of the Selma Chalk (equivalent to the Annona Chalk of Louisiana and Arkansas). The oil has little gas in solution, and practically no gas is produced with the oil, which is asphaltic and of 34° gravity. It is not known whether Tinsley is a deep-seated salt dome or a true anticlinal structure. A 40-acre spacing and a 2000/1 gas–oil ratio have been enforced.

The Glass dome and the Blakely prospect in Warren County are due for tests, and there are other attractive structures. G. D. H.

222.* Nebraska and Forest City Basin Produce First Oil. F. B. Taylor. *Oil Wkly*, 13.11.39, **95** (10), 72–76.—Oil has been found by a rank wildcat in extreme South-east Nebraska. A 24-hour pumping test gave 230 brl. of oil. The productive Hunton lime was topped at 2276 ft. and was drilled to 2282 ft. Forty-seven dry holes have been drilled in the Forest City basin. The main geological feature of the area is the Nemaha granite ridge, which runs approximately north–south. The strata dip abruptly from the ridge, and to the east of the well the sediments slope off gradually into the Forest City basin. A number of surface structures are known, but drilling has only given shows of dead, heavy oil. East of the ridge, and well into the basin, there has been seismic work and core-drilling. Deep-seated anticlines have been located, and a north–south trend is thought to have been established, but these more pronounced features have not been drilled. The Viola and Hunton limes are thought to be more likely to have commercial oil than the deeper Wilcox or Simpson. G. D. H.

223.* Arabia, Vital Crude Reserve of Near East, has Still Brighter Future in Oil. C. R. Spencer. *Oil Wkly*, 4.12.39, **95** (13), 16–20, 22.—The first concession was granted in 1933 for an area bordering the Persian Gulf. In 1937 geophysical work was begun, and in 1938 core-drilling.

The general conditions in Arabia with regard to life, labour, and other features are discussed.

Production in 1939 was 275,000 brl., whilst the potential was 900,000 brl. Some sixteen wells were producing, and seven were being drilled in October 1939. A 10-inch pipe-line has been built from Dammam to Ras Tanura.

Production has been obtained in Kuwait, and tests are being made at Abu Hadriya, midway between Kuwait and Dammam.

Bahrein has a reserve of 150,000,000 brl. of oil, and Dammam is expected to have 300,000,000 brl. There are other geophysical highs. G. D. H.

224.* General Considerations in Estimating Reserves of Petroleum Capable of being Produced at the Different Concessions (Venezuela). M. Guadalajara. *G. Rev. del Min. Fomento* (*Venezuela*), September 1939, II (16), 491–510.—The problem of estimating the reserves of petroleum economically obtainable from an oil-field presents obvious difficulties. The author discusses various methods and presents calculations and curves. A commonly used method is to estimate the volume, porosity, and saturation of the sand or rock containing the oil. For example, if the area in question is 20 million sq. ft., the sand 25 ft. thick, spacing of the wells $\frac{1}{5}$ of the area, saturation degree $\frac{1}{2}$, recoverable oil $\frac{1}{2}$, then the total production would be $20{,}000{,}000 \times 25 \times \frac{1}{5} \times \frac{1}{2} \times \frac{1}{2}$ cub. ft. of oil. When records of the outputs of wells in a field are available, curves may be plotted for the areas and districts. Such curves will generally show a certain percentage reduction from year to year, and in this way it is possible to estimate future production. Particulars are given of other methods in use.

Attention is directed to various possible sources of error, such as the conditions arising when all the wells in the field are not sunk at the same time, in which case the later wells will affect the results, due to interference. Similarly the abandonment of some wells will increase the output of the remainder. Other variants are fully discussed.

Probable outputs are worked out for a number of fields based on the curves shown, but it is pointed out that not until 1930 were continuous records regularly kept. In these calculations the curves of declining output are extrapolated to the years when further extraction would not be considered economical.

The author has gone to a great deal of trouble in looking up such records as are available in order to arrive at the conclusions in respect to future outputs given in this article.

He winds up by saying that it will be seen that the work can only be regarded as a trial effort which may serve as an introduction to future studies which may be undertaken in his country. H. I. L.

Geophysics.

225.* Refraction and Reflection of Seismic Waves. II. Discussion of the Physics of Refraction Prospecting. C. H. Dix. *Geophys.*, 1939, **4** (4), 238–241.—The physical process by which the refracted wave is generated is discussed. After the pulse from a given source reaches the critical position where the refracted wave-front is normal to the interface, the wave travelling in the lower medium starts to draw away from the pulse in the upper medium. As a result of stress relationships and the conditions of continuity at the interface, the pulse in the lower medium must give rise to a disturbance in the upper, and this travels along the interface with the velocity of waves in the lower medium. It is this travelling disturbance which is the source of the wave used in refraction prospecting. The intensity depends on the elastic constants and densities of the two media, the distance of the source from the interface, the variation of velocities in the lower medium, the curvature of the interface, and the intensity at the shot point. The effect of velocity variation and curvature of the interface is briefly discussed.

The effects of shear-waves are not mentioned, but as the process applies equally to them, it may be expected that each travelling source of disturbance will generate both shear and compression waves. S. E. C.

226.* Seismic Paths, Assuming a Parabolic Increase of Velocity with Depth. C. E. Houston. *Geophys.*, 1939, **4** (4), 242–246.—In the case where velocity is a function of depth only, $v = v(y)$, various forms of the function $v(y)$ have been suggested. The assumption of a linear variation of velocity with time leads to a parabolic velocity depth function, and this example is discussed in the present paper. It is of interest in that the equation of the wave-paths can be obtained, the time–distance curve of the direct wave can be computed, and the corresponding reflection time–distance curves can be obtained graphically. S. E. C.

227.* Areal Plan of Mapping Subsurface Structure by Refraction Shooting. L. W. Gardner. *Geophys.*, 1939, **4** (4), 247–259.—The following methods may be applied to areas in which the beds are more or less level, and in which there is at least one suitable marker horizon. In new areas it is necessary to carry out preliminary shooting to determine the necessary working conditions. With the detectors located at suitable distances from shot points, the sum of the two delay times at positions offset from the shot point and detector positions for each set-up may be determined. The average of the delay times may be generally regarded as giving a rough measure of each, but methods are described whereby the relative and absolute delay times are obtained from geometrically interrelated set-ups. These methods are applicable when approximate values of offset distances are known. If shots are made on two set-ups arranged to have a common offset position, the difference in depth at the two free ends may be calculated. The system can be extended to a group of set-ups with the detectors arranged on a ring around the common offset. Undulations of the marker horizon below this ring will then be determined. Another arrangement involves three set-ups arranged in triangular form, such that each offset position of one line coincides with one offset position of an adjacent line. By this means the absolute delay times, and hence depths, may be determined. By combining these two methods in the form of a system of triangles and hexagons, it is possible to shoot over an area and determine the depths and undulations of the marker horizon. S. E. C.

228.* Dip Reflections on Two Faults in the Gulf Coast. F. F. Campbell. *Geophys.*, 1939, **4** (4), 260–270.—The algebraic sum of the dip determinations around any particular traverse is termed "misclosure," and the problem then is to decide whether this misclosure is due to errors in observation or to faulting. The results of two surveys in the Gulf Coast are given in illustration of the problem. In one case the amount of misclosure and the quality of the work make it apparent that faulting must be present. In the other case geological evidence was necessary before the presence of a fault could be assumed. No sharp line can be drawn between the effects of faulting and those of observational errors. It is recommended, however, in the case of a large misclosure on

a reconnaissance survey shot with less than 100% control, that the original traverse be cut up with lines shot for 100% control. Then, if the misclosure is concentrated by the additional shooting, faulting is the probable explanation. S. E. C.

229.* **Shallow Resistivity Survey at South Elton, Louisiana.** E. E. Blondeau. *Geophys.*, 1939, **4** (4), 271–278.—The survey was made in the usual manner with standard D.C. resistivity equipment. Conductivity contours were drawn for the cases where the potential electrodes were 100 and 300 ft., 400 and 600 ft., and 900 and 1100 ft. from the near current electrode. The contour map on the deep zone is comparatively uniform, whilst that on the middle zone shows a little more variation. The conductivity contours on the shallow zone, however, are extremely complex. The results obtained on the shallow zone are compared with an Eltran survey in the same area, and excellent agreement is obtained.

In discussing the cause of the wide conductivity variations in the shallow zone, it is pointed out that the anomalous portions of the section are high conductivity strips of surface material. If the cause of the high conductivity is mineralization, then it must be purely a surface phenomenon. The more probable cause, however, lies in the history of the surface-beds which are of deltaic and lagunal origin. Any association of these shallow anomalies with deep structure is highly improbable. S. E. C.

230.* **Note on the Relation of Suddenly Applied D.C. Earth Transients to Pulse Response Transients.** G. E. White. *Geophys.*, 1939, **4** (4), 279–282.—The experimental difficulties of obtaining the derivatives of the voltage transient from the suddenly applied D.C. results are practically insurmountable. If, however, a sharp D.C. pulse is applied to the earth, lasting, for instance, less than 0·001 sec., then the observed transient would approximate to the time derivative of the transient obtained from the suddenly applied D.C. case. It is shown that a definite possibility exists of measuring this type of response, using reasonable power voltages. S. E. C.

231.* **Recent Developments in Eltran Prospecting.** P. W. Klipsch. *Geophys.*, 1939, **4** (4), 283–291.—Difficulties encountered in the null method have been overcome by the introduction of a new mixing circuit, a new means of synchronizing the opposing wave with the detected wave, and a simplified synthesizing circuit. These are described, and it is shown that by combining the synthesizing circuit with a low-power, square-wave generator separate from the rest of the circuit, it is possible to calibrate the rest of the apparatus.

A new method of measuring the wave-shape distortion—the Sawtran method—has been introduced. Instead of producing a wave form which opposes the detected wave and produces a null, the detected wave is subjected to further distortion until a predetermined wave-shape is produced. The method measures a single characteristic of the detected wave, such as the time constant, and its use is a distinct advantage in areas where the wave-shape is not too complex.

The use of cameras in conjunction with the cathode-ray oscillograph is an advantage, in that they afford permanent records, they give checks on data collected by dial readings, the wave-form can be detected through an electrical haze, and the records can be subjected to detailed analysis. S. E. C.

232.* **Proposed Geophysical Method for Orientating Cores.** V. Vacquier. *Geophys.*, 1939, **4** (4), 292–299.—It is suggested that a short pilot hole be drilled and this hole then filled with a suspension of highly magnetized particles, the suspending medium being such that it will solidify and adhere firmly to the rock. The upper part of a core subsequently taken by normal coring methods will then contain the polarized, magnetic material and can be tested with a portable magnetometer. In this manner the core may be orientated. S. E. C.

Drilling.

233.* **Test Indicates Potentialities of Diesel-Electric Rig for Deep Drilling.** H. F. Simons. *Oil Gas J.*, 30.11.39, **38** (29), 32.—This long paper is the first of a number appearing in a special section of the November issue of the *Oil and Gas Journal*, and describes

Mid-Continents deepest test—Continental Oil Companies' No. 1 Proctor, which was recently plugged back to 14,582 ft. The chief object of the test was to discover geological facts which could indicate the trend of further prospecting in the area.

More than 15 months were required to drill the test to its total depth, and the last 3 months were spent mostly in fishing. A full description of this phase of the work is given at the end of the paper. At present the test is active, plugging back and testing operations being in progress.

The drilling rig used was a diesel-electric rig, which has been used both in other deep wildcats and in proven fields. The main units were two Fairbanks-Morse, opposed-piston, two-cycle, six-cylinder, 300-h.p. diesel engines with a speed range from 900 to 1200 r.p.m. Each engine drove directly a 140-kw. and a 50-kw. direct-current generator and a 25-kw. exciter through V-belts. Details of engines, generators and exciters, and of the panelling arrangement are given.

The arrangement gave great flexibility, as three circuits were available to the driller. Any one generator or any combination of generators could be connected to any motor desired. Examples are given of different systems of connections for various drilling, hoisting, and mud-mixing operations.

The description of the switchboard reveals many interesting safety arrangements which render it foolproof.

Many details are given of the actual equipment used in drilling this test well, including derrick equipment and drill-pipe used. Every precaution has been taken by the operators to prevent damage to the equipment, possible blow-outs, and injury to men. The preventer used may be operated by mud, water, or air pressure, with valves for its control located on the floor. Safety precautions are summarized.

The paper then describes the operations undertaken in, and the history of, drilling the test. The drill-pipe stuck at a depth of 14,479 ft., and many attempts were necessary before it could be freed. A description of this fishing job has already appeared in the Press (*Oil Gas J.*, 28.9.39). The fish was finally side-tracked.

A. H. N.

234.* Rôle of Metals in Deep-Well Drilling. W. L. Nelson. *Oil Gas J.*, 30.11.39, **38** (29), 37.—The difficulties which are encountered in deep-well drilling and the severe conditions existing may be emphasized by noting a few facts about operations similar to those of Proctor No. 1, such as :—

(1) At 14,479 ft. the stretch of the drill-pipe is 12–14 ft., or about 0·1%. Many ordinary carbon steels would be permanently deformed under such a load.

(2) Derricks are required to support more than 500,000 lb., or 250 tons—equivalent to a bundle of 167 automobiles, each weighing 1½ tons.

(3) Bits having a cutting diameter of only 4 or 5 in. must sustain a load of 1000–1500 lb./sq. in. of hole. If bits were rods, this stress would not be excessive; but they are movable mechanisms, and much of the load is centred on the cutting edges rather than evenly distributed, and, furthermore, the bits revolve two to four times per second.

The development of new steels is described, and it is seen that such developments are gradual processes. After laboratory studies, a proposed steel is put into commercial operation and carefully watched for months or years. Should difficulties develop, they are overcome by heat-treating the new batches of steel in different ways. These experiments take years, and hence steel practice must be summarized over a period of years rather than day by day. Such a summary is made.

The paper gives in tabular form strength and hardness of oil-field steels and their approximate relative cost, and examples of modern and older steels used in drilling operations.

From the text and the tables it may be summarized that, from the standpoint of strength alone, present-day steels range from 50% to even 250% stronger than those used in early drilling practice. The values of greater hardness, wear resistance, freedom from failures, and increased speeds of drilling are factors which make it impossible to evaluate the real advantages of the newer steels.

A. H. N.

235.* Mud Control is Big Problem on Continental Deep Test. D. B. Edwards. *Oil Gas J.*, 30.11.39, **38** (29), 38.—Practices employed in the drilling of Proctor No. 1 were not

commonly used in Mid-Continent drilling, and hence mud treatment was unusual. Only one mud change was necessary—between 10,176 and 14,491 ft. Chemical treatment and the use of artificial mud made it possible to maintain a mixture which had low water loss, low initial gel strength, moderate 10-minute gel strength, and thin cake-forming qualities, despite the contamination from salt-bearing formations, acid and oil used in attempting to free stuck pipe, and the drilling of cement.

The conditions existing in the well at various times determined the type of mud necessary and the treatment which was needed to obtain it. A brief description of the drilling of the well and equipment used is therefore given, to establish the background for the mud treatment.

The artificial mud was used until a depth of 3500 ft. was reached, when aquagel was added to bring the viscosity to 35 sec. Below 5000 ft. the viscosity was kept between 35 and 40 sec. A.P.I., and the density ranged from 9·8 to 10·2 lb./gal. Loss of mud became troublesome below 9250 ft. This was undoubtedly due to the flocculated condition of the mud, resulting from its high salt content. Because of losing mud into the formation, a good sealing mud was needed which would release gas easily at the surface; yet it was essential that the mud should have sufficient viscosity to carry out the cuttings and sufficient gel strength to hold the cuttings in suspension when circulation ceased. A table is given showing the limits set on the properties of the mud which possessed all these desirable qualities.

The control necessary to keep the mud within these limits is detailed. A derrick man tested the weight and Marsh funnel viscosity of the mud at the well at regular intervals of 15–30 mins., and regulated the flow of the chemical solution being used to treat the mud at the time in accordance with the instructions received from the engineer or the tool-pusher.

Other tests on the mud, such as the Stormer viscosity, gel strengths, *p*H value, and filtration qualities, were made daily by the engineer. These tests indicated the type and quantity of admixtures to be used in the treatment of the mud.

The mud used in drilling the lower part of the well had four peculiarities: (1) a very low water loss; (2) a thin cake formation; (3) extremely low initial gel strength; (4) moderate 10-minute gel. These factors and the various controls used are described in detail, and the advantages and drawbacks of each are stated.

The effects of the acid and a study of *p*H values of the mud are of particular interest.

A. H. N.

236.* Metals in Drilling. W. L. Nelson. *Oil Gas J.*, 30.11.39, **38** (29), 69.—This is the ninth of a series of papers devoted to the metallic materials used in drilling wells. Previous articles have dealt with portable servicing equipment, slush-lamps, rotary-chain, rotary-table, hoists, engine-castings, pulley-blocks, and bits.

In this paper the metals used in tubular drilling equipment are discussed. Inspection of equipment, troubles and difficulties arising from manufacturing points of view—such as the large volume of the equipment preventing easy heat-treatment—or from the view-point of use, such as the severe and complex stresses arising in a drill-pipe subjected to twisting, bending, tension, and even compression stresses, are all briefly summarized. A table is given showing the approximate composition, in terms of per cent. carbon, manganese, chromium, nickel, and molybdenum, the approximate physical properties in terms of yield point, elongation, and Brinel hardness, and the heat treatment of metals used in tubular drilling equipment. The properties discussed have been taken from published statements of metal manufacturers, fabricators, and field-men. References are given.

A. H. N.

237.* Safety When Drilling Deep Tests. Anon. *Oil Gas J.*, 30.11.39, **38** (29), 76.—In this short article are summarized various precautionary arrangements found to yield an increased factor of safety in deep drilling, particularly in unproven localities. Actually it appears that men on deep tests are generally in less danger of injury, despite the increase in the work, than those on shallow tests, because of safety appliances and practices in use.

A photograph of an actual "safe" rig is reproduced and the various items are described, together with their advantages.

A. H. N.

238.* Shell Overcomes Caving to Bring in Coastal Well. N. Williams. *Oil Gas J.*, 7.12.39, **38** (30), 55.—Excessive cavity conditions and caving formations encountered by a certain company in drilling one of its wells in coastal Louisiana presented many difficulties and problems that would ordinarily have discouraged most companies from continuing operations. However, through persistent efforts, involving a number of unusual procedures, these were successfully overcome, and operators were finally able to complete the well as a good producer.

The paper describes in detail the many and varied operations involved in drilling and completing this unusually difficult well to a total depth of 7704 ft. In addition to the numerous cement plugs used and conventional muds and chemicals provided in attempts to plug and seal cavities in porous formations, a total of 1475 bales of Fibrotex, 200 sacks of cotton-seed hulls, 80 sacks of rice bran, 21 tons of sawdust, and 5444 empty sacks, including gunny-sacks, mica, and cloth-cement sacks, were pumped into the hole. Altogether 124 days were required in overall time for drilling the well from the time the hole was spudded until its completion. A. H. N.

239.* Metals in Drilling. W. L. Nelson. *Oil Gas J.*, 14.12.39, **38** (31), 53.—The paper deals with miscellaneous alloy equipment. These pieces of drilling equipment are of such a varied nature that they cannot be treated as a whole. Because of the extreme importance of cost, a brief and general comparison of the relative costs of the various low-alloy steels is included. The alloys that are recommended have been reviewed in published information from recognized steel companies, fabricators, and from discussions with field men.

The approximate compositions, in terms of percentage carbon, chromium, nickel, and molybdenum, and the approximate physical properties (yield point, elongation, and Brinell hardness), together with suggested heat treatments, are given for such pieces of drilling equipment as tool-dressing implements, tong handle, inserts, link-pins, kelleys, drill-jars, etc. A. H. N.

240.* Oklahoma Deep Test Well. B. Mills. *Oil Wkly*, 27.11.39, **95** (12), 39.—In this lengthy paper the author describes drilling, fishing, and cementing operations undertaken in the second deepest well, Proctor No. 1, together with geological structures and other interesting items. Drilling to 14,582 ft. with medium-weight equipment points to future depth records far below those currently regarded as "deep."

The chief outstanding mechanical developments in drilling Proctor No. 1 were: cementing 9⅝-in. casing at 10,173 ft.; cutting out 2250 ft. of drill-pipe between 12,229 ft. and 14,464 ft., squeeze-cementing of porous formations below the 9⅝-in. casing, and successful use of diesel-electric equipment. Each of these achievements affords interesting study.

Mud conditioning and control are described and certain peculiarities of the mud noted, such as the low initial gel strength attained and the advantages accruing therefrom.

Diesel-electric power has been used exclusively for drilling this deep test. The equipment and power connections are detailed. Fuel consumption runs from 400 to 900 gals. daily.

A table gives the subdivisions of the formations which have been encountered. Several shows of gas have been noted between 10,700 ft. and 13,400 ft. in thin, sandy limestones and conglomerates, the porosity of which is relatively low (shown by electrical survey). It is planned to test thoroughly all shows before completion. A. H. N.

241*. Rotating while Cementing Proves Economical. B. Mills. *Oil Wkly*, 4.12.39, **95** (13), 14.—Constant rotation of casing during cementing operations has become an important phase of completion operations in one field in South Texas. This novel practice has been used by one company while cementing the oil string in about 175 wells, and no failure has been recorded.

A sectional view, as well as a photograph and description of the equipment used, are given in the paper. The basis for successful rotation of casing during cementing operations has been straight holes, long threads and couplings or casings, assurance

that casing is free before rotation starts, and suitable rotating equipment. Rotation has been applied only to cementing full oil-strings.

Completion depth in this particular field averages 5925 ft. The 5-in. casing-string is rotated steadily for an hour in an 8¾-in. hole, the rotating time including the mud-conditioning, cement-mixing, and pumping-down periods. The casing is rotated from 25 to 30 r.p.m., and rotation stops about the time the cementing plug reaches bottom. Power required to turn the casing is negligible. No damage to clamps or dies used to rotate the casing has occurred. A. H. N.

242.* **Quick Means for Finding Number of Barrels in a Casing String.** W. F. Schaphorst. *Oil Wkly*, 4.12.39, **95** (13), 30.—This is a nomograph giving the capacity in barrels of strings of casing, given the diameter and depth of the well. The way of using the simple chart is illustrated. A. H. N.

243.* **Michigan Gets its First Natural Flowing Trenton Lime Well.** N. X. Lyons. *Oil Wkly*, 11.12.39, **96** (1), 36.—The first high-potential, naturally flowing Trenton lime-stone well, source-bed of Ohio's oldest oil-fields, ever developed in Michigan, is causing considerable interest, but is not likely to precipitate anything in the proportion of a boom.

The drilling practice and completion methods followed in bringing in this well are detailed, as well as the financial and other interests; and the geological structure and previous production records of the field are discussed. A. H. N.

244.* **Temperature Effects on Oil-Well Drilling. Part I.** M. T. Halbouty. *Oil Wkly*, 18.12.39, **96** (2), 10–16. Paper presented before American Institute of Physics.—As wells have been drilled to constantly greater depths, increasingly higher temperatures have been encountered, and it is now recognized that this condition will have important influences on oil and gas drilling and producing methods. Consequently this paper on the subject is of interest and value. No attempt is made to review every particular phase where temperature affects drilling and production, only those cases where temperatures have an influence from an economical standpoint and how these effects are dealt with scientifically being discussed.

Because of its length, the report is divided into two parts for publication. Part 1 discusses temperatures affecting oil-well drilling; Part 2 describes temperatures affecting crude-oil production, and discusses the geothermal gradient present in Gulf Coast oil-fields.

One of the most important effects of temperature on drilling is that of increased temperature on drilling mud. Whilst the effects of higher temperature on the density of muds are negligible, they add to the problems of mud control by increasing the mud's viscosity—hence making viscosity control more difficult—and also by decreasing the effectiveness of the mud in its wall-building operations in the hole.

It is believed that, despite the cooling effects of the drilling mud on the bit, high-friction temperature is perhaps the principal reason for a case-hardened rock-bit drilling less than 10 ft. of hole in extreme cases.

It is only recently that high bottom-hole temperatures have seriously impaired cementing operations. When drilling depths increased to below 6000 ft., the bottom-hole temperatures of 150–170° F. that were encountered rapidly increased the setting time of ordinary cement. This fact, together with the additional delay in pumping cement through 6000 or 7000 ft. of casing, has been directly responsible in several cases for the cement setting inside the casing and becoming immovable when a small part had passed out through the casing shoe, thereby improperly cementing the hole and causing unnecessary delay in drilling out several hundred feet of cement in the casing. These facts and their effects on the development of improved cement are discussed. Methods for the location of cement behind casing by temperature measurements are illustrated.

This part of the paper ends with a discussion on electrical temperature logging with survey instruments, correlation in drill-holes by means of subsurface temperatures, location of gas–oil levels and points for the entry of water into the well, and finally with a discussion on the economic importance of temperature measurements.

A. H. N.

245.* Drilling Activity Continues above 1938 Trend. L. J. Logan. *Oil Wkly*, 18.12.39, **96** (2), 36–38.—Drilling activity in the U.S.A. during the first eleven months of 1939 is detailed in pictorial and tabular form. November activity brings the number of well completions for 11 months of 1939 near the 1938 level, whilst the field activity on December 1st was considerably greater than that existing in the corresponding period of 1938. A. H. N.

246.* Simultaneous and Continuous Electric Logging and Drilling Achieved. B. Mills. *Oil Wkly*, 1.1.40, **96** (4), 16–20.—Continuous electric logging of formations while simultaneously conducting regular oil-field drilling operations is described, and the various implements for carrying the circuit to the bottom of the hole are shown pictorially.

The circuit consists principally of a battery connected to a meter, which in turn is connected to leads running to the derrick. The main lead runs up the standpipe, around the rotary hose, to a brush-box containing an ordinary collector ring and a set of brushes. The circuit is then taken past the kelley by a special conductor. Thence it leads down the drill-pipe through special connections to the drill-collar assembly, which consists of an insulated bakelite section above the bit, a testing-switch and a special steel drill-collar to provide weight and rigidity.

Although only one cable is used between the bit and the surface, both the earth potential and the impedance are recorded on meters at the surface. A small alternating-current oscillator is used to energize the cable. The impedance meter is not affected by the direct current, whilst the potential or direct current is not affected by the impedance measurement. The earth potential is measured in millivolts, the resistance in ohms. The earth potential is measured direct from the bit as direct current.

The log made while drilling is checked by re-surveying the hole. Part of the drill-pipe is pulled, a dummy is snapped on, and the bit run back into the hole as a check. It is also easy to go back into the well and pick up portions of the hole fully surveyed while drilling.

The drill-pipe and most of the other equipment are handled as if they were conventional items. The pipe itself is standard grade, only the pressed-in connections in the tool-joints and the brazed conduits running down each joint differentiating the assembly from an ordinary drill-pipe. Experienced operators are, however, kept on the well, as interpretation of the electric log involves technicalities not usually understood by an ordinary drilling crew. A. H. N.

247.* Heaving Shale Research Programme is Instituted. Anon. *Oil Wkly*, 1.1.40, **96** (4), 32–33.—The paper outlines the future programme of research to be carried out in the University of Texas, but the analysis of the problem in designing the programme renders it of general interest. It appears that the problem may be classified under several distinct divisions, the major ones being (1) regional studies; (2) types of heaving shales; (3) causes of heaving shales; and (4) combating heaving shales.

An outline of the basic principles and the programme of research to solve the problem is given. A. H. N.

248.* Drilling and Completion of 10,000-ft. Well in Louisiana Gulf Coast. H. L. Flood. *Petrol Engr*, December 1939, **11** (3), 29.—The most important discovery of the year on the Gulf Coast of Louisiana is a very recently completed well. This is the second well to be drilled on the structure, located apparently on the flank of the structure, drilled through a fairly thick section of gas and condensate formation, but drilled deeper to discover one of the thickest, and what may be one of the most prolific oil reservoirs discovered recently in Southern Louisiana. A total of 140 ft. of oil-saturated sand was logged in the well, of which only 45 ft. is being produced through perforations in the casing. Potential of the well is 1710 brls./day through $\frac{3}{4}$-in. choke. Pressure on the tubing-head is 1750 lb./sq. in.

The drilling history of the well and the equipment used are given. Drilling of this well has been characterized by lack of trouble—a fact attributed not only to the experienced crew, but also to the accurate mud control undertaken by a competent mud engineer on the job. This practice of relegating mud control to one responsible expert is advocated for the success of any deep-drilling project. A. H. N.

249.* Deep Test Drilled by Diesel-Electric Rig H. L. Flood. *Petrol. Engr*, December 1939, **11** (3), 42.—An extensive account is given of the drilling history of, and equipment used for, the second deepest hole in the world. The most interesting features of the equipment used were :—

(1) The installation of a complete auxiliary hoisting unit and pump as a standby ;

(2) The re-designed electrical controls permitting extreme flexibility in operation ;

(3) The opposed-piston diesel engines used to drive the generators.

The opposed-piston diesel engines employed on this rig have not been used extensively as drilling power, although the design is widely employed in marine service. Operating on the two-cycle principle, these six-cylinder engines have, in reality, twelve cylinders. Six pistons, each 5 in. in diameter, and having a 7-in. stroke, are attached to a crankshaft above, and six pistons are attached to a crankshaft below. Instead of compressing against a fixed head, as in an ordinary engine, the pistons compress against each other. The expanding gases resulting from the explosions thus exert force against both pistons simultaneously. The lower crankshaft is directly connected to the generators ; the upper crankshaft is linked to the lower one by an enclosed chain drive. A detailed description of this engine appeared in the *Petrol. Engr*, May 1936. A. H. N.

250.* New Pocket Transit Combines Functions of Several Instruments. L. Suverkrop. *Petrol. Engr*, December 1939, **11** (3), 69.—A description is given of a light-weight instrument designed for the use of engineers and geologists doing reconnaissance work which serves as compass, transit, level, clinometer, sextant, and alidade. Detailed account is given of the methods employed in each type of work. A. H. N.

251.* Characteristics and Requirements of Portable Well-Servicing Units. W. K. Atcheson. *Petrol. Engr*, December 1939, **11** (3), 121.—*Paper presented before Petroleum Transport Association.*—Performance of well-servicing units differs from that of most other types of equipment that operate from an engine. In pulling rods or tubing it is necessary to start and to accelerate the load without changing gears until a stop is made to unjoint the rods or tubing—a condition imposed because there is no momentum built up to carry the load while the gears are shifted.

Fundamentally, all well-servicing units are similar. The ability of any servicing unit to move and to accelerate a given weight depends on the power characteristics of the engine and the speed reduction provided in the gears of the transmission, chain sprockets, and the number of lines strung through the blocks.

The author discusses the characteristics of engines and gives the method of determining these characteristics. The change of torque with speed and the brake h.p. developed at various speeds are studied from first principles. The pulling ability of the engine is analysed, and the effects of clutch characteristics, gear ratios, and number of lines in the blocks are illustrated by simple examples which are completely worked out. A. H. N.

252.* Radial Filtration of Drilling Muds. M. Williams. *Petrol. Tech.*, November 1939, A.I.M.M.E., Tech. Pub., No. 1112.—The filtrate which penetrates the strata may present a serious problem in many instances. The factors which determine the rate of such infiltration have been studied, and a series of curves and equations has been developed which permits the distance of penetration to be estimated. Since the dimensions of the hole and the rate of mud circulation are usually fixed by drilling conditions, variation of these to reduce filtration is impracticable. Mud control is the obvious solution.

Each mud presents a different problem with regard to securing optimum filtration properties, but there are certain general facts : (1) dispersing agents reduce filtration, while coagulating agents increase it ; (2) the predominance of particles of colloidal dimensions ordinarily is conducive to low filtration rates.

Experimental and theoretical treatment of axial and no-flow conditions is given, and the possibility of filling the hole with a filter-cake is considered unlikely to occur except with a mud of exceptionally bad filtration characteristics. G. D. H.

253.* Detection of Radioactive Cement in Cased Wells. L. G. Howell and A. Frosch *Petrol. Tech.*, November 1939, A.I.M.M.E., Tech. Pub., No. 1113.—An early apparatus has been modified so as to permit measurement of the relative intensities of gamma rays from radioactive elements occurring naturally in geological formations along the walls of a bore-hole and behind the casing. Comparison of the absolute magnitude of the open-hole and cased-hole logs reveals that there is some absorption by the casing, but the outstanding features of the log are still maintained, and the gamma-ray log shows a remarkable correlation with electrical logs. In general the sands show up as radioactive "lows" and the shales as radioactive "highs."

If radioactive material, such as carnotite, is added to cement, the apparatus can be used to detect the position of the cement. The method is more flexible than the temperature method, in that it is not necessary to make the survey while the cement is still setting; the circulation of the mud has no disturbing effect; the concentration of ore added to the cement can be varied to give a sufficiently large change in gamma-ray intensity even though the treated cement may be pumped behind old cement. However, it must be remembered that the location of formations behind radioactive cement cannot be made with this method since the feeble radioactivity of the formations is masked by the strong radioactivity of the cement. G. D. H.

254.* Effect of Temperature on Plastering Properties and Viscosity of Rotary Drilling Muds. H. T. Byck. *Petrol. Tech.*, November 1939, A.I.M.M.E., Tech. Pub., No. 1116.—The plastering properties of six representative Californian drilling muds have been studied over a temperature range of 70–175° F. at several mud weights, using a high-pressure circulating filter press with full-size consolidated cores. In all tests, with untreated as well as with chemically treated muds, the filtration rates at elevated temperatures were higher than at low temperatures, and in nearly every case this increased filtration rate was notably larger than could be attributed solely to the decreased viscosity of water at elevated temperatures. It appears that no existing method will permit even an approximate determination of the filtration rate at high temperature from data at room temperature. It is necessary to make measurements at the temperature expected in the well, or to make a sufficient number of tests at lower temperatures so that a small extrapolation of the data to the expected well temperature may be applied. Such tests should be made on the mud as used in the well.

The viscosity of each of the muds was determined over the same temperature range. While no relationship was noted between mud viscosity and plastering properties, it was found that chemical treatment of the muds for viscosity reduction shifted the temperature of minimum viscosity to appreciably higher values than for untreated muds. G. D. H.

255.* Study of Some Phases of Chemical Control in Clay Suspensions. A. D. Garrison and K. C. T. Brink. *Petrol. Tech.*, November 1939, A.I.M.M.E. Tech. Pub., No. 1124.—The viscometer used was of the rotating cylinder type with an inverted hollow cylinder as rotor in a mud-filled annulus. The speed was capable of variation and the torque could be observed. The data are given for approximately equilibrium conditions. Measurements on kaolin, silica, sulphur, and barium sulphate suspensions gave straight lines when the viscosity (ordinates) was plotted against the reciprocal of the rate of revolution, and their slopes and the intercepts on the viscosity axis are in the order of the concentration. It appears to be a general principle that the intercept is higher the greater the relative volume of the suspended solid, and the slope is higher the greater the tendency for the solid particles to adhere together. It appears also that the more rapid the rate of flow the smaller becomes that part of the viscosity that is due to the inter-particle forces of attraction.

The viscosity-speed relations for bentonite suspensions are substantially different from those for relatively non-colloidal solids. The curvature obtained was demonstrably due to the presence of very small particles.

The viscosity of a clay suspension is due to: (1) the viscosity of the suspending medium; (2) the viscosity normally attributable to the obstructional effects of solid particles; (3) the forces between the solid particles tending to give relative rigidity; (4) hydration of the particles. The curvature shown by bentonite suspensions at high rates of revolution is attributed to loss of the hydrated envelope on the particles.

The effects of adding various chemicals to the suspensions have been studied and interpreted in the light of these possible viscosity factors. The deflocculating agents that have commonly been used seem to be those which influence structural viscosity only. To control hydration is not so simple. It involves such methods as an exchange of ions on the clay surface for less hydrated ions, or a complete removal of such ions as is obtained during electrodialysis, or by the dehydrating effect of an excess of some water-soluble salt or of dehydrating liquids such as alcohol or acetone.

G. D. H.

256.* **Dispersion of Clays and Shales by Fluid Motion.** A. D. Garrison, K. C. T. Brink, and P. B. Elkin. *Petrol. Tech.*, November 1939, A.I.M.M.E. Tech. Pub., No. 1125.—It has long been recognized that the viscosity of a clay suspension depends on the past history of the fluid motion. In examining the effects of long-continued uniform motion a concentric cylinder rotating viscometer was used, with a standard rate of rotation of 600 r.p.m. It was observed that in clay suspensions capable of forming rigid gel structures, the time required for the attainment of an equilibrium viscosity value was frequently as long as 30 min. On continued shear some suspensions showed an increase in viscosity after passing through a minimum. It was found that the increase in viscosity was dependent on the age of the suspension, its concentration, the *p*H value, the nature of the metallic ions associated with the clay, and the presence of certain deflocculating agents. It is clear that an increase in *p*H above 7, and up to 11·1 at least, involves a substantial increase in the rate at which the viscosity rises under continuous motion. This is probably associated with an increase in colloidal dispersion and the resultant increase in hydration.

On giving a twelve-hour rest to a suspension treated with alkali or alkaline-earth hydroxides there was a drop in viscosity and in *p*H value, presumably due to chemical changes. Examination of the distribution of particle sizes in stirred and unstirred clay suspensions showed an increase in the percentage of fine particles and/or of hydration in the former case.

The bearing of the work on drilling operations is discussed. G. D. H.

257.* **Drilling Patents.** M. M. Kinley. U.S.P. 2,185,303, 2.1.40. Appl. 1.7.38. Wire-line shooting-tool comprising a body, with an opening for, and means for gripping the wire line and shearing it at a point below the gripping point. Both the gripping and shearing mechanisms are actuated positively.

W. P. Rogers. U.S.P. 2,185,316, 2.1.40. Appl. 13.8.38. Deep well-drilling apparatus with a mast for a derrick suitable for cable-tool drilling.

G. E. Green. U.S.P. 2,185,337, 2.1.40. Appl. 7.1.38. Machine for slitting well-casings and the like.

S. P. Tschappat. U.S.P. 2,185,478 and 2,185,479, 2.1.40. Appl. 3.4.37 and 13.5.37, respectively. Casing- and tubing-heads.

N. C. Brewer. U.S.P. 2,185,702, 2.1.40. Appl. 8.7.38. Roller chain.

A. W. Buckner. U.S.P. 2,185,723, 2.1.40. Appl. 3.2.38. Cable clamp.

F. J. Young. U.S.P. 2,185,822, 2.1.40. Appl. 6.11.37. Rotary swivel.

A. H. N.

Production.

258.* **Electrical Logs Locate Shots in Illinois Sand Wells.** H. F. Simons. *Oil Gas J.*, 30.11.39, **38** (29), 59.—In efforts to improve the wells by shooting to maximum advantage, while at the same time minimizing the dangers of water encroachment, one company has introduced "shooting control" in the Louden field in Fayette County, Illinois.

Under this method no well is shot until the electrical logs have been carefully studied by the geological department, which recommends the size of the shot and its location

in relation to the sand. Through this practice the amount of water produced has been materially reduced, and the wells are generally in good position to plug off water in case it becomes excessive.

The three productive sands of the Louden field are described, together with the details followed before placing a shot. The effectiveness of the selective shooting-control method is evidenced by the large number of wells not so treated having a high percentage of water, with a consequent treating problem, whilst the wells carefully shot still have low water production. A. H. N.

259.* Engineers Study Full Effect of Water Flooding in Bradford. J. P. O'Donnell. *Oil Gas J.*, 7.12.39, **38** (30), 43.—A study of a property that has almost reached the limit of its economic life as defined by present methods of production makes it evident that the Bradford field will still represent an oil reservoir of considerable magnitude after water-flooding has passed. This property will have a residual oil content of 10,238 brl./acre, or 56·2% of the original. However, the residual saturation will be but 25%. The field is the world's outstanding example of stimulating oil production by water-flooding. In recent years it has been producing from 37,000 to 49,000 brls. daily, 95% of which is being obtained from water-flooded properties.

The early development of the field from 1871 onwards is briefly outlined, and its life since it last changed ownership (1929) is detailed.

Eleven times as much water was injected as there was oil recovered, and five times as much water was produced as oil. The volumetric efficiency of this operation, on the basis of barrels of water injected to barrels of oil produced, is 9%. With 98·5% of the anticipated ultimate recovery already obtained, total recovery is estimated at 43% of the original content. The five-spot pattern was followed.

Tables and graphs give the characteristics of the property. A relatively unimportant figure in the discussion of water-flood properties is the actual life. This is because of the fact that during the first 5 years of development from 80% to 90% of the recoverable oil is produced, and the remaining 10–20% may be produced over a period of from 5 to 10 years. The principal controlling factor in the ultimate life of such a property is the price of the crude, which, after the production has fallen to an average of a fraction of a barrel per well per day, will, if high, prolong the life and, if low, will shorten it.

It was concluded that (1) the price of crude oil during the "depression decade" relegated water-flooding operations in this field definitely to the marginal class; (2) water-flooding, while it made continued operation of this field possible, was an inefficient, though effective, method of operation; (3) because of this inefficiency, the field will still represent an oil reservoir of some magnitude after production by present methods of water-flooding has been exhausted. A. H. N.

260.* Circulating Hot Oil in Wells. L. P. Stockman. *Oil Gas J.*, 21.12.39, **38** (32), 34–35.—In order to reduce paraffin troubles and also the viscosity of the crude produced from deep wells in the Montebello field of California, one company has devised a means for circulating a portion of the crude. During circulation the crude is heated in an exchanger through which hot engine-cooling water passes. The heated crude is forced down the production line through a small pipe suspended inside the producing string.

A diagrammatic sketch of the heat-exchange system and several practical hints to ensure the success of the project are given. A. H. N.

261.* Survey of World Oil-Fields. Anon. *Oil Gas J.*, 28.12.39, **38** (33), 76.—A complete list is given of the production activities of the world oil-fields under the headings of the respective countries in which they are located. The data are for (1) number of producing wells; (2) daily average production in barrels; (3) number of drilling wells; (4) producing depths in feet; (5) gravity of the crude, A.P.I; (6) base of the crude; (7) outlet market for the crude; and (8) age of the field in years. A. H. N.

262.* Steady Advance in Production Methods. Anon. *Oil Gas J.*, 28.12.39, **38** (33), 190.—This paper is published in the "International Number" of the *Oil and Gas*,

in both English and Spanish. It is an extensive review of production problems and their solutions, illustrated generously by photographs and diagrams. Well-spacing and organized drilling are the first problems discussed, followed by practices employed in modern rotary drilling requiring large drilling equipment and using more weight on the bit. Straight-hole drilling technique is discussed in conjunction with drilling-time studies, and power considerations, both from the prime mover and transmission view-points, are made.

In cable-tool drilling the outstanding development has been the perfection during the past year of a dynamometer that makes it possible to select the most suitable stroke. Cable-drilling technique is studied critically.

Electrical logging and core-orientation methods are reviewed. Completion practices are studied, and gravel packing, the use of removable pipe-sections in casing both by drilling and by acid action, and of cement-lined liners, are explained.

The problems encountered in flowing wells are briefly discussed before pumping wells are dealt with, attention being given to agitators and semi-agitators.

The paper ends with a review of the practices followed in gas-injection reservoirs, pressure conservation and restoration schemes, and finally in water-drives.

A. H. N.

263.* Range of Application of Gas-Lift Methods. Part I. E. C. Babson. *Oil Wkly*, 27.11.39, **95** (12), 15.—*Paper presented before American Petroleum Institute.*—This article presents the results of an investigation of gas-lift methods conducted under the auspices of the Production Practice Committee of the American Petroleum Institute's Division of Production. Pressure held against the formation and gas requirements are evaluated for: (1) straight gas lift; (2) plunger lift; (3) intermitters; and (4) gas-displacement pump. Comparisons of various methods are given and some suggestions made for application of the results to actual production problems. Because of the great length of the study, it is published in several parts.

In this, the first part of the paper, the author discusses the scope of the investigation and deals with cost of compressing gas, straight gas lift, gas lift through 2½-in. tubing at various depths and in various fields of the United States.

The behaviour of a producing well is the result of two sets of components: (1) characteristics of the well; (2) characteristics of the lifting equipment. The well characteristics depend on the behaviour of the producing formation and on the manner in which the well has been drilled, cased, and completed. In this discussion the chief items studied are (1) reservoir or static pressure; (2) productivity index; (3) formation gas–oil ratio; (4) per cent. water; (5) depth; (6) size and condition of casing; and (7) size and condition of liner.

The most important characteristics of any gas-lift method, on the other hand, are (1) back pressure held against the formations; and (2) gas consumption. The effectiveness of the installation is a function of the back pressure held against the formation; whereas the lifting efficiency is determined largely by the gas consumption.

The paper is particularly rich in graphs illustrating the various points enumerated here.

The pressures at the bottom of the tubing have been estimated from the casing pressures by applying the following equation, which has been found to give satisfactory results in the Dominguez field :—

$$P_g = (P_c + 15)(1 + 0{\cdot}022h) - 15$$

where P_g = pressure at the bottom of the tubing, lb./sq. in.
P_c = casing pressure, lb./sq. in.
h = tubing depth, thousands of ft.

For deep wells it is assumed that the pressure at the bottom of a 10,000-ft. well would be identical with the pressure at the bottom of two superimposed 5000-ft. wells. The method is discussed and illustrated.

It is believed that the limits of the error of the curves covering costs of straight gas-lift through 2½-in. tubing and in the range of production rates of 100–400 brls./day and depths of 4000–6000 ft. are less than ± 10%. The limits of the error, however, are variable.

264.* Nine Deep Pumping Wells Have One Rod Break in 2½ Years. F. B. Taylor. *Oil Wkly*, 4.12.39, **95** (13), 24.—This is the twenty-eighth article in the series dealing with oil-well pumping problems. It describes the system at one lease where allowables are made without undue expense for breakdowns or replacements. On a basis of volume brought to the surface, the one-rod breakdown represents a total of 827,000 brl. of fluid between the time the various wells went on the pump and 1st November, 1939.

The operation of the pneumatic lifts installed is described. The polish rod is actuated through attachment to a double piston arrangement. Compressed air or gas is used to drive the power end, which is within the lower cylinder, whilst the upper piston rides under a cushion of oil.

Precautionary measures and safety devices against sudden dangers are described, as well as the performance of the equipment. The lease is outstanding in efficiency. The per barrel lifting cost is exceedingly low. The record is due not only to the equipment used, but also to the efficient, clear, and safe way the equipment is operated.

A. H. N.

265.* Range and Application of Gas-Lift Methods—Part 2. E. C. Babson. *Oil Wkly*, 4.12.39, **95** (13), 34.—*Paper presented before the American Petroleum Institute.*—Part I of this paper is abstracted under No. 263, and there the scope of the investigation and its ultimate purpose have been described.

In this, the second part, investigations are made on the cost of gas-lift operations in a 3-in. tubing similar to those undertaken on 2½-in. tubing in the first part. A great number of curves are presented and full sets of data are discussed in detail. The methods used here are the same as in the previous work on 2½-in. tubing, but where differences arise these are given in full.

In the range of 300–800 brl./day, 75–150 lb./sq. in. tubing pressure, and 5000–8000 ft. depth, the performance curves for 3-in. tubing are probably as reliable as those for 2½-in. tubing. On the other hand, the limits of error at low tubing pressures, low rates of production, and shallow depths may not be as satisfactory.

Information on gas-lift through sizes of tubing other than 2½-in. and 3-in. is too meagre to permit the development of reliable relationships.

Similarly, data on gas-lift through the annular space between casing and tubing are far from satisfactory, in that they are either insufficient in quantity or are poorly distributed over the range of conditions. As a result, the operating characteristics of casing-flow gas-lift can be established only partly. In an attempt to evaluate the characteristics of flow between 6⅝-in. casing and 2½-in. tubing, approximately 100 cases were obtained from production records. Pressures were estimated for the bottom of the tubing by a suitable formula, and graphs of performance plotted.

The data were unsatisfactory and the results obtained were consequently inferior in definition and importance to those obtained with the 2½-in. and 3-in. tubing.

The results of an experiment on gas-lift between 6⅝-in. casing and 2½-in. tubing in a 4800-ft. well are given.

A. H. N.

266.* Dual Separator Ensures Dry Gas for Power. Anon. *Oil Wkly*, 11.12.39, **96** (1), 18.—In this, the twenty-ninth article of the pumping series of the *Oil Weekly*, a description is made of a field pumping installation, using gas drawn from the mains serving a lease, in which a dual separator installation at the engine-house divides the regulator load and ensures proper dryness of fuel furnished to the engine.

A. H. N.

267.* Range and Application of Gas-Lift Methods. Part 3. E. C. Babson. *Oil Wkly*, 11.12.39, **96** (1), 22.—This is the third part of the exhaustive paper read before the A.P.I. on this subject. Further results are reported for gas lift between 6⅝-in. casing and 2½-in. tubing, and for gas-lift operations between 8⅝-in. casing and 2½-in. tubing.

A discussion on straight gas lift follows. The effects of water appear to be complex. The pressure at the bottom of the tubing is usually, but not always, higher in a wet well than in a corresponding clean one. The gas consumption of a wet well is often higher than that of a corresponding dry well—the explanation being the need for excess gas to prevent segregation of the water.

A hypothesis is advanced to explain the fact that some wells require very small quantities of gas for lifting oil.

Methods for calculating the energy available in 1 lb. of flowing mixture and for calculating bottom-hole pressures from surface readings are given. Graphs illustrate efficiency and density of mixtures at the well-head pressures.

The general types of flow-valves are described and the method of operation is outlined. When compressor capacity is limited, wells equipped with flow-valves can be produced with the minimum quantity of gas necessary to maintain steady flow. Should a well die, it will usually be kicked over automatically within a few minutes. Under curtailment, the value of the flow-valves increases. The important part played by flow-valves in making intermittent gas-lift methods practicable is discussed and other advantages are outlined. The chief contributions of flow-valves appear to be convenience and flexibility.

The working of plunger-lift devices is next studied in detail and its advantages are discussed. Results are reported for 2½-in., 3-in., and 4-in. plunger lifts. In a discussion on plunger lift the pressure at the bottom of the tubing appears to be obtainable from the formula :

$$P_B = P_t + KQH$$

where P_B = pressure at bottom of tubing, lb./sq. in.
P_t = minimum tubing pressure, lb./sq. in.
Q = rate of production, brl./day.
H = depth, thousands of ft.
K = a constant, 0·190 for 2½-in. lift ; 0·115 for 3-in. lift ; and 0·064 for 4-in. lift.

Part 3 of this paper ends with a discussion on closed-system intermitters. The paper is rich in diagrams and illustrations—forty-seven figures appearing in the first three parts. A. H. N.

268.* Effect of Reducing Pump Submergence. M. L. Mayfield. *Oil Wkly*, 18.12.39, **98** (2), 17 ; also cf. *Oil Gas J.*, 14.12.39, **38** (31), 44, and *ibid.*, 21.12.39, **38** (32), 41.—By making tests and studying the individual well's producing characteristics, such as permeability, bottom-hole pressure, and productivity index, the efficiency of reducing the pump submergence can be predicted before permanent equipment is installed. It is concluded from the data obtained from the tests that where the practice of reducing pump submergence is applicable, definite advantages and disadvantages may accrue to the operator.

The advantages are : (1) The initial pumping-equipment investment may be decreased by $1850 per well as compared with past practice. (2) The well is not damaged by this practice, and it is possible that some retardation of water encroachment may occur. (3) Operation and maintenance expense will be decreased, due to the smaller equipment and shorter rod-string. (4) Horsepower required will be reduced by 46–55%, or a saving of 4–7 h.p. per installation. Peak well-loads will be decreased from 8800 lb. to 4200 lb. at twenty-one strokes/min., *i.e.*, a reduction of 52% or more is obtainable. (5) The application will extend from the initial installation time until the well is either fully depleted or has nearly reached this point. The savings effected by deferring cash requirement will more than offset the infrequent additional costs incurred should a larger unit be necessary for depletion.

It may also be concluded, from data on five leases, that the rate of decline of the static fluid level is 50 ft./year.

The disadvantages are : (1) Unless proper and sufficient pump submergence is obtainable and attention is given to the pump, " gas locking " may occur, which not only decreases the pump volumetric efficiency, but also causes unpredictable stresses to be imposed on the surface equipment. (2) Unless strict supervision and proper design of the sub-surface equipment are made to prevent misapplication of the smaller-rated units, a financial loss due to equipment failure may result. (3) Misplaced working barrels might create excessive pulling expense, although this could be limited by multiple barrel installation. (4) It is essential to make a preliminary test and detailed study of the individual wells before a permanent setting is made, and this will cost approximately $150 per well. A. H. N.

269.* Equitable Proration of Marginal Leases in East Texas. I. I. Gardescu. *Oil Wkly*, 25.12.39, **96** (3), 12–14.—Last June, when a Federal District Court declared the method of prorating wells in East Texas field void, owing to failure to consider acreage and oil in place, the ownership of many millions of barrels of oil not yet produced from the pay horizon was placed at stake. In view of the enormous reserve still in the ground—from 1750 to 2750 million barrels—a nominal change in the method of apportioning proration allowables might shift the ownership of a great volume of oil.

The East Texas field is considered a water-driven field, and, as such, for every barrel of oil recovered from a down-dip marginal lease many other barrels of oil have migrated from the lease, up dip, to be produced by wells located in more favourable structural locations.

The author explains the mechanism of production from such fields and discusses various suggestions made to render the proration of marginal leases in such fields equitable. A. H. N.

270.* Temperatures Affecting Crude Oil Production. M. T. Halbouty. *Oil Wkly*, 25.12.39, **96** (3), 15–19.—*Paper presented before American Institute of Physics.*—It is pointed out that while, in recent years, numerous reports have been published on the conservation of natural reservoir energy in the form of pressure, the study of sub-surface temperature, which provides another source of natural reservoir energy, and the effects of these temperatures on the flow of oil and gas through the sand, has been sorely neglected. The scope of the paper is limited to effects of temperature on production at the surface.

Solar heat is the principal factor to be considered in a discussion of the effects of temperature on production. A study is made of wax and paraffin deposits affected by temperature and methods for removing them or preventing their depositions. Chemical type of treatment may be either the type which generates heat, thereby raising the temperature of the oil and melting the paraffin or increasing the solubility in the oil, or the type which acts as a solvent to change the character of the wax so that it will not crystallize when the temperature is decreased below its original melting point. The practical difficulties encountered in applying either method are discussed.

The use of steam, either in coils or by injecting it directly into the pipe, is next studied.

The economic importance of high bottom-hole temperatures is illustrated by reference to practices followed by various companies and the advantages accruing from such practices. Finally heat-treating crude-oil emulsions is made the subject of discussion on the effects of temperature on the economics of production.

The paper ends with a discussion on the geothermal gradient present in the Gulf Coast oil-fields. The apparent concentration of heat near salt domes may be partly explained by the fact that salt is an excellent conductor of heat, and assuming that the salt plug extends to depths in excess of 20,000 ft., the high temperatures existing at this depth would be more readily transmitted through the salt mass than through adjacent sedimentary formations. A. H. N.

271.* Range and Application of Gas-Lift Methods. Part 4. Conclusion. E. C. Babson. *Oil Wkly*, 25.12.39, **96** (3), 20.—The first cost of most intermitter installations is relatively small; emulsion trouble is usually not so severe as with straight gas lift, and the intermitter can be made to produce volumes of liquid as large as 2500 brl./day. Sub-surface mechanism of the intermitter, however, can seldom be repaired without pulling the tubing from the well.

If production from an intermitter is regarded as a series of slugs which flow into the filling-chamber, and are pushed one at a time up the tubing, the pressure held against the formation should equal the height of the slug multiplied by the density of the fluid. Available data indicate that the actual pressures are much higher than the results of such calculations. Methods of measuring these pressures are detailed. It is believed that intermitters are applicable primarily to the production of wells with medium static pressures and high productivity indices. Advantages of intermitters are described.

The gas-displacement pump is essentially an intermitter designed to function without a packer through the use of a full string of "macaroni" tubing hung inside con-

ventional tubing. The arrangement is considered as a separate method, and its characteristics and range of operation are studied in detail. It appears that the gas-displacement pump is directly competitive with sucker-rod and hydraulic pumps; but its application is limited to wells producing less than 200 brl./day.

A general discussion on all methods of gas-lift is given in this extensive paper. The various methods are compared against each other under similar conditions by graphical means. The relative economy of each method is evaluated graphically for certain conditions.

The paper ends with a discussion on the ranges of application of various gas-lift methods. It appears impossible to establish rigid ranges of application for the various methods, because the performance desired from a well is dependent on many variables, such as lease requirements, proration schedules, budget provisions, compressor facilities, demand for a particular grade of oil, and competitive conditions. However, in order to illustrate a point of view, some very generalized ranges of application—representing good practice on a large, relatively non-competitive lease—are shown in a diagrammatic form. The areas representing range of application are predicated upon a compromise between maximum production and minimum gas consumption, and not upon either factor alone.

The paper contains fifty-nine figures, many of which represent four charts each, each chart containing a number of interesting graphs. A. H. N.

272.* **Predicting Wet Gas Recovery in Re-cycling Operations.** J. S. Swearingen. *Oil Wkly*, 25.12.39, **96** (3), 30.—The discovery in recent years of a number of fields that yield a new type of petroleum production—the condensate or distillate type—has created new operating problems. Of particular importance at this time, due to the newness of such fields, is the estimation of ultimate yields, especially in view of the belief that it is advisable to instal re-cycling plants, which necessitates additional investment.

The prediction of ultimate recovery of condensate from a producing horizon where the residue gas is returned to the formation through another well is dependent on an estimate of the area displaced by the dry gas in this re-cycling operation, before the dry gas reaches the producing well. The problem is dealt with here as a study of two-dimensional displacement of the wet-gas layer by the injected dry gas. To show how rapidly the producing well may be expected to dry up after the dry gas reaches it, and what will be the shape and position of the dry-gas area, electrical models have been used, and the results are shown graphically in this paper.

A layer of electrolyte the ion content of which represents the gas content of the sand will respond to potential differences in exactly the same manner in which gas in the formation will respond to pressure differences. The electrical apparatus consisted essentially of half-cells representing wells and a layer of electrolyte solution on a glass plate, and made firm by a 2% agar content, the film representing the gas-saturated horizon. This agar solution was protected from drying by a covering sheet of thin mica. A small hole was drilled in the mica for each "well location." Numerous electrical models of fields of various shapes and well positions were made and tested, and successive patterns of the dry-gas area were made to scale. Details of the apparatus are given.

The results are given, and there appears at least one check on the method. It is understood that the Keeling well in the Long Lake field dried up approximately 9 months after a nearby re-cycling plant was put into operation. The application of the method checks the result.

It is contended that injection wells near the property lines are objectionable, as 30% or 40% of the dry gas may go under the adjoining lease. A. H. N.

273.* **Petroleum-Reservoir Liquid Production Problems.** K. Eilerts, R. V. Smith, and A. B. Cook. *Oil Wkly*, 1.1.40, **96** (4), 27.—This article is an abstract of the Bureau of Mines Report of Investigations, No. 3474. The summary of the full paper, of forty-seven pages and containing fifteen figures and fifteen tables, is as follows :—

Methods for determining properties of a reservoir fluid that are of particular significance to production practice have been developed. The equipment and procedure essential to the methods have been briefly described and the data obtained from a

typical reservoir fluid are presented. Practical applications of the data are illustrated, and suggestions are made regarding the additional information necessary for important extensions of the applications.

Apparatus developed include : a steel pyknometer for measuring the specific volume of fluids having high vapour pressures; a simplified variable-volume cell for determining the expansibility of fluids under conditions of phase equilibrium; and a fractional distillation assembly for analysing the gas and liquid hydrocarbon samples.

Analytical data are presented on a complete set of gas and liquid samples taken during a well flow-test. The composition and properties of a prepared reservoir fluid and three of its residua obtained by liberation of dissolved gas are given. Isotherms were determined for the four fluids in 30° F. intervals for the pressure range from 3000 to below 50 lb. per sq. in. abs.

The loss of energy from frictional effects was evaluated for two fluid production rates in each of three sizes of flow-string. Sub-surface pressures measured in a shut-in well off-setting a flowing well were applied to interpolation of the pressure gradients through the oil-producing structure at four rates of flow. The effect of changing fluid properties on the values of the gradients and the significance of the change in limiting withdrawal rates are discussed.

A development of particular interest to the petroleum technician is the analytical method described for comparing the compositions and other properties of hydrocarbon liquids obtained at different points in the flow-stream. The amount of gas liberated from liquid solution and the resultant volume change in the solvent can be determined without knowledge of the pressure and temperature gradients and the type of liberation in the flow-stream between the points at which the sample is taken. Production engineers are concerned with the decrease in energy that occurs as reservoir pressures decline, because the methods and rates of recovery depend on this factor. The energy available by expansion of reservoir fluids having compositions corresponding to three stages of depletion were estimated from experimental data obtained from residua of the original fluid. A. H. N.

274.* Simple Dynamometer Card Analysis Method. S. B. Sargent. *Oil Wkly*, 1.1.40, **96** (4), 30–31.—The stresses and motions involved in sucker-rod pumping are treated mathematically as a problem in vibration. The method advocated in this short paper is simple, rapid, and appears to indicate a reasonable answer to the problem. Its value is, however, limited to wells where the tubing is anchored. In cases where the tubing is not anchored, a modification is suggested. This modification seems to be taking a dynamometer card on the tubing itself and adding vectorially the motion of the barrel to that of the sucker-rods or the plunger. A. H. N.

275.* Limitations in Producing Wells with High Water-Oil Ratios. F. B. Taylor. *Oil Wkly*, 1.1.40, **96** (4), 43–44.—Wells in certain fields have to be abandoned despite the fact that they are potential producers of 50 or more brl./day, because to produce this quantity the operator has to lift from twenty to thirty times as much water. In cases like these abandonment is apparently the best method of storing the oil as a known major reserve to be drawn upon in future years, when reserves are less plentiful and production methods will be more efficient.

After reviewing cases actually occurring in such fields, it becomes evident that there are three major angles of approaching an economic solution :—

(1) Possibility of reducing cost of operations.
(2) Increasing fluid volumes.
(3) Improving lifting means.

The first is limited, as neither labour, taxes, nor operating charges can be appreciably reduced. The second solution of increasing fluid volume provides a parallel decrease in high maintenance costs, and this trend is now under way. The third solution is exemplified by the use of submerged centrifugal pumps, hydraulic-actuated lifts, pneumatic lifting units, and rotary pumps which have given operators added leeway in many areas. A. H. N.

276.* Heating and Dehydrating Natural Gas at the Well-Head. J. E. Moore. *Petrol. Engr*, December 1939, **11** (3), 27.—Where well-pressures are high and temperatures low, the natural gas operator encounters problems that are intensified if severe climatic conditions characterize the area in which operations are conducted. Because whole communities are often entirely dependent on gas for heat, and because even brief interruptions of the gas supply would entail much suffering and inconvenience, the operator in such territories must know that the solutions found for these problems are correct in principle and are dependable in practice.

The author describes practices in two major gas-producing states of the North-west (U.S.A.), where gas is produced at elevations of 4000–8000 ft. above sea level, under pressures ranging upward to approximately 2500 lb./sq. in., and where winter temperatures sometimes fall to — 50° F. These conditions cause peak-hour loads to run as high as twenty-five times the minimum summer loads.

To avoid the hazards of carrying extremely high pressures in the field gathering-lines, the gas pressure is reduced at the well-head. The resulting need for application of heat to counteract the refrigerating effects of expansion is satisfied by hot water or steam heaters, and not by direct heating, in order to ensure safety. Steam systems can meet variable demands more effectively. The peculiar advantages of each system are discussed.

The gas is cooled and the condensates are removed before delivery into the lead-lines. Particular attention is paid to removing all hydrates prior to the gas leaving the plant. Calcium chloride brine contactors are used. A. H. N.

277.* Electric Submersible Well-Pump Performance. W. H. Stueve. *Petrol. Engr*, December 1939, **11** (3), 38.—Although this paper deals with energy consumption and lifting costs specifically for the St. Louis Pool, Oklahoma, it is believed that the results will have a more general application to other pools. The production is from an average depth of 4100 ft. by about 800 wells, sixty-one of which are equipped with electric submersible well-pumps. The first of these pumps, of 97½-h.p. capacity, were tried out in this field in 1934. Fluid was lifted at the average rate of 1700 brl./day, with an average energy consumption of 1·35 kw.hr./brl., and an overall efficiency from wire to fluid in the surface tanks of about 45%. The average oil recovered was approximately 9% of the total fluid pumped when considered over a period of years for all pumps of this type in use.

Tables and graphs are supplemented by analysis of the problems. It is found that the conditions in many wells necessitate pumping at as high a rate as possible in order to obtain profitable operations. Many large-capacity wells, when producing at the rate of about 400 brl./day, yield only water and a negligible amount of oil, yet, were the same wells pumped at a rate of 1400–1700 brl./day or greater, the percentage yield of oil to water would increase by as much as 10%. A. H. N.

278.* Scrap Metal Abandoned by the Oil Companies. A. P. Burguillos. *Rev. del Min. Fomento* (*Venezuela*), July 1939, II (14), 83–105.—The author discusses the feasibility of utilizing the large quantities of scrap metal abandoned by the oil companies at different places where they have been operating. He suggests that it would be worth while to start works equipped for the manufacture of small implements and tools, such as picks, shovels, hoes, and the like. In order to carry out such a scheme it would be necessary for the State to restrict the re-export of scrap materials, and especially those which were originally imported free of duty.

The general legal aspect is examined and the opinion expressed that any person prepared to pay the cost of transport would have the right to remove and utilize the materials scrapped. It is suggested that the proposal is worth consideration in view of the marked rise in the cost of materials, especially metals, due to the immense amount of rearmament taking place at the present time. H. I. L.

279.* Phase Diagram of a Mixture of Natural Gas and Natural Gasoline Near the Critical Conditions. D. L. Katz, D. J. Vink, and R. A. David. *Petrol. Tech.*, November 1939, A.I.M.M.E. Tech. Pub., No. 1114.—A phase diagram showing boundary curve and quantity of liquid in the two-phase region was determined for a mixture of natural gas and natural gasoline in the regions of its critical conditions. The temperature and

pressure of the phase measurements were in the range of 85–212° F. and 1300–2600 lb./in.², respectively, with the critical condition at 169·5° F. and 2615 lb./in.² absolute.

The pressure drop required to change the system from a uniform phase to a definite percentage of liquid became smaller as the temperature was raised above 85° F. Striking colour phenomena accompanied the measurements near the critical temperature. At pressures considerably above the two-phase region the system was colourless. As the pressure was lowered towards the bubble or dew point the single phase took on a reddish colour. At temperatures near the critical the colour was a bright mahogany red, but a faint colour was perceived over the entire range 102–192° F.

No unusual change was observed in the shape of the pressure-volume curves for the two-phase system in passing from temperatures below the critical temperature to the region of retrograde condensation. The plot of saturated density appears to be a smooth curve for the bubble-point liquid below the critical temperature and for the dew-point vapour above the critical temperature. G. D. H.

280. Production Patents. L. F. Rollins. U.S.P. 2,185,522, 2.1.40. Appl. 28.10.37. Well-flow controlling device consisting of perforated section in a casing positioned at flow strata and plugs for filling the perforation to shut off the flow of fluids through these perforations and movable means for holding the plugs in place.

E. W. Patterson. U.S.P. 2,185,680, 2.1.40. Appl. 17.6.36. Well-pumping mechanism using a sampson post, walking beam and pneumatic balancing apparatus creating and maintaining a constant air pressure.

M. A. Elliott. U.S.PP. 2,185,725 and 2,185,726, 2.1.40. Appl. 12.5.38 and 21.12.38. Adapter coupling for joining rigid and flexible pipes, the latter for pipes of different diameters.

E. S. Semmons. U.S.P. 2,185,727, 2.1.40. Appl. 3.8.36. Hydraulic pump.

J. Preston. U.S.P. 2,185,925, 2.1.40. Appl. 29.9.38. Oil-well oil saver.

A. H. N.

Transport and Storage.

281.* Review of the U.S. Bureau of Standards Work during 1939 on Underground Corrosion. K. H. Logan. *Oil Gas J.*, 21.9.39, **38** (19), 112.—Recent investigation by the National Bureau of Standards on soil corrosion has been along the three following lines: (1) analyses of soil corrosion data provided by pipe-line operators; (2) development of tests and methods of measurement which may be of immediate practical value to corrosion engineers, and (3) studies of corrosion processes.

1. Statistical surveys of the average physical condition of pipe-lines are made, based on the average depth of the deepest corrosion pits. These are correlated with tests on the corrosivity of samples of soil adjacent to the pipe, but present indications are that the correlation is not close. If a considerable number of samples are taken, however, a rough indication of probable corrosion can be obtained.

2. The determination of the potential required for adequate cathodic protection of lines is frequently based on the copper sulphate electrode or half-cell, but this may give misleading results, owing to variations in the purity and hardness of the copper electrodes, aeration, light, and temperature. These factors have now been studied, and suitable corrections are available. It is also recommended that they should only be used with indicating instruments for which they were designed or with potentiometers, since with indicators of low resistance, polarization and other causes give erroneous results. An improved type of copper cell has been devised, and it is felt that the voltage and current density required for cathodic protection can now be determined. Experimental work on operating lines will be put in hand when the laboratory work is completed.

3. The most promising test of soil corrosivity is considered to be the use of an electrolytic cell in which the current flows from the anode through the soil to a cathode of the same material as the anode, but kept at a different potential by differential aeration. The loss of weight in the anode indicates the corrosivity of the soil. Indications of this are also given by the change in potential of the electrodes as the current is

increased by means of superimposed voltages, the measurements being made while the current is interrupted, for which purpose mechanical or electronic methods have been devised. Loss in weight of anode is also in line with the order of current density at the corrosion potential (potential at which current density-potential curves intersect), and it may be possible to correlate soil corrosivity with the maximum short-circuit current in the corrosion cell. For many soils the rate of corrosion is determined primarily by the rate of the cathode reaction, but in some cases marked polarization of the anode takes place, indicating the formation of protective films. The loss of protective coatings of corrosion products by *e.g.* diffusion in marshy soils is studied in glass cells in which the movement of membranes, formed by reaction between ferrous ions diffusing towards the cathode and hydroxyl ions and oxygen moving towards the anode, could be followed. Membrane development at appreciable distances from the anode is associated with a high rate of corrosion, whereas in slightly acid or alkaline soils it is found in contact with the anode, corrosion being thereby partly inhibited.

C. L. G.

282.* Determining Minimum Current Required to Provide Adequate Cathodic Protection. Part I. D. Harrell and M. Clerk. *Petrol. Engr*, October 1939, **11** (1), 38–44.—In applying cathodic protection the negative potential at which corrosion ceases is of a definite magnitude, so that any excess is a waste of power. The loss-of-weight method hitherto applied has the disadvantage of measuring the maximum safe limit and not the more economic safe limit of the potential. The method evolved for determining the minimum potential has been arrived at from a consideration of the phenomena observed in the application of cathodic protection—viz., deposition of metallic iron, increase of soil alkalinity and evolution of hydrogen at the cathode (pipe) and a corresponding increase of corrosion, evolution of acid-radicle gases, and increase of acidity at the anode. From a consideration of these facts an evaluation of the minimum protective potential has been deduced. It is shown that this potential is characterized by (1) a decrease of the ferrous iron concentration at the cathode to virtually zero, (2) a sharp increase of hydroxyl concentration at the cathode, (3) total ionic concentration reaches a minimum at which point hydroxyl-ion concentration equals the ferrous-ion concentration, (4) decomposition of the water and evolution of hydrogen begins, (5) a further increase of potential effects little reduction of ferrous ion, the energy inducing the evolution of hydrogen.

R. J. E.

283.* Distributed Anode Method Cuts Cost of Cathodic Protection. O. C. Roddey and L. R. Sheppard. *Oil Gas J.*, 21.9.39, **38** (19), 84.—Investigations on the prevention of electrolytic corrosion have been carried out by the Interstate Natural Gas Co. using as laboratory a portion of line in Tensas Swamp La. selected in August 1932. It has been shown that the installation of ground beds at 50 and 100 ft. and to a smaller extent at 700 ft., using 200 amps. at 47 volts, gave excessive potentials directly opposite the units, whereas a few hundred feet down the line there was barely enough to prevent corrosion. A system of distributed anodes was devised using anodes carrying much less current (59 amps. at 3·3 volts) at 37–50 ft. intervals located 25 ft. from the line. Power requirements for successful protection of pipe, using copper oxide rectifiers and distributed anodes, are given as: 13·1 amp. per mile for 22-in. pipe hot enamel-coated in 1926; 8·3 amp. per mile for 14-in. pipe asphalt coated and wrapped with roofing felt in 1925, and 8·0 amp. per mile for 13-in. pipe hot enamel-coated in 1926. The anodes, consisting of 2 × 80 in. plain electrode furnace carbon impregnated with hot paraffin, have shown very little increase in resistance over 5 years service, and should theoretically last 50 years.

C. L. G.

284.* Microbiological Anaerobic Corrosion of Steel Pipe-lines. R. F. Hadley. *Oil Gas J.*, 21.9.39, **38** (19), 93.—A review is given of research on the corrosion of steel pipe-lines by anaerobic sulphur-reducing bacteria, and of the examination of corroded pipe-lines in swampy areas with reasonably high soil resistivity. The presence of ferrous corrosion products on pipe in water containing sulphate indicates bacterial reduction. The conditions required for bacterial corrosion activity were found to be: (1) the presence of air-tight or water-saturated ground with little motion of the water, (2) a *p*H value of 6·2–7·8, and (3) the availability of organic food. The primary strain of sul-

phur-reducing bacteria (*Vibrio desulphuricans*) has been shown to be relatively insensible to wide temperature ranges (0–80° C.), and, being in size 2μ to 5μ long by 0·5μ wide, are readily visible under a microscope. The process of attack postulates the utilization by the bacteria of the hydrogen of polarization from cathodic areas in the reduction of the combined oxygen of the sulphate ion forming H_2S and water. The ferrous ions are precipitated by the hydrogen sulphide as ferrous sulphide and by the hydroxyl ions as ferrous hydroxide, thus lowering the solution pressure of the ferrous ions and accelerating the corrosion process owing to the removal of the cathodic hydrogen polarization. The presence of ferrous sulphide on a corroded pipe is a reliable indicator of the presence of sulphur-reducing bacteria. Corrosion by this means is of abnormal intensity, and cathodic protection against it is of doubtful value. This problem is, however, being studied. C. L. G.

285.* Cathodic Protection and Polarization of Underground Pipe-Lines. R. J. Kuhn. *Oil Gas J.*, 21.9.39, **38** (19), 98.—The importance of the protection against further corrosion afforded by the hydrogen formed by polarization of galvanic couples in pipe-lines is discussed and the factors affecting polarization are outlined. The current discharged from the pipe at anodic spots of corrosion collects on cathodic areas of the pipe accompanied by a deposit of hydrogen on the surface of the pipe and by the formation of a layer of alkaline earth, due to the removal of the acid hydrogen ion from the adjacent earth. The rate of corrosion is checked by the resistance effect of the hydrogen and by the change in potential owing to the hydrogen coating. In dry areas the hydrogen may be quickly removed by atmospheric or dissolved oxygen, whereas in wet areas it may be retained, so that the state of the soil has a great bearing on the rate of corrosion. Reconditioning of an old line or installation of a new line will frequently cause very rapid corrosion to take place on the new section, owing to the removal of protective films and to potential differences between the old and new lines. Similarly corrosion test-holes are liable to undergo rapid subsequent corrosion. Depolarization may also be caused by oxygen-producing bacteria. The potential applied to give cathodic protection may also be reduced by the formation of a film of hydrogen on the areas of the pipe on which cathodic currents are collecting. C. L. G.

286.* Method for Applying Thick Asphalt Mastic Coating. N. W. Colley. *Oil Gas J.*, 21.9.39, **38** (19), 150.—A description is given of a rapid method developed in California for the application *in situ* of a dense asphalt mastic coating to pipe-lines. After ditching and raising the pipe, it is cleaned by a travelling cleaning machine equipped with scrapers, knives, and cutters, and sand-blasted in two stages, pits being subsequently spot welded and the pipe patched where necessary. A primer is then applied by two pressure spray-guns, and covered under pressure with a seamless uniform coating of asphalt mastic, consisting of a dense, carefully graded mixture of sand, limestone dust, asphalt, and asbestos. The latter is manufactured in a mobile hot plant and applied by a special travelling expanding nozzle to a thickness of ½ in. at speeds varying from 8 to 14 ft. per minute. The nozzle is equipped with expanding quadrants, which allow for coating over patch plates, high welds, etc.

A similar process is in use at railhead and central plant operation for the coating of new or reconditioned pipe. Reconditioning is effected by first cutting out welds and collars, straightening and then heating in a furnace, where internal residues and external paint, etc., are removed. It is then heated to an annealing temperature to remove internal stresses, gradually cooled, and the pipe-ends are bevelled for subsequent welding. Finally, it is cleaned with steel grit in a roto shot-blast machine, pits and thin spots are built by electric welding and any roll welds made, and, after testing, coated with primer, asphalt mastic, and whitewash. C. L. G.

287.* Location and Installation of Ground Beds. D. F. Ball. *Petrol. Engr*, October 1939, **11** (1), 91–94.—The selection of test instruments for the measurement of soil resistance is discussed and the A-C fall-of-potential method recommended. The use of a modified version of this method for surveying an area to select the site of the ground-bed is described. The relative merits of vertical and horizontal ground-beds are dependent on conditions. The former has the disadvantage of passing through a number of soil strata which may vary in resistance, whilst the resistance of the latter is

subject to seasonal variations. To obtain good pipe-to-soil contact the use of sodium or calcium chloride is recommended, and the method of applying this treatment, effectively, is described. R. J. E.

288.* Ten-Year Trial Shows Success of Inert Gas System. M. G. Van Voorhis. *Nat. Petrol. News*, 18.10.39, **31** (42), R. 441.—The displacement of combustible gases in storage tanks, refinery vessels, and in tankers by inert flue gases as a fire preventative and for the production of safe working conditions is a system which has proved to be notably effective. A number of small generating plants are distributed at strategic points about the refinery, adequate safety measures, especially where the units are on board tankers, being taken. The purging process is normally controlled and its progress followed by means of gas analysis by the Orsat method. H. G.

Gas.

289.* Cost of H_2S Removal from Refinery and Sour Natural Gas. B. Storrs. *Oil Gas J.*, 19.10.39, **38** (23), 69.—Treating data are presented on three Girbotol plants for the removal of H_2S from (*a*) 5000 cu. ft. per day of stabilizer gas containing 5% of H_2S, reduced to max. 30 grains per 100 cu. ft.; (*b*) 6700 cu. ft. per day of stabilizer gas containing 300 grains H_2S per 100 cu. ft. reduced to max. 10 grains per 100 cu. ft., and (*c*) 8000 cu. ft. per day of natural gas containing 163 grains per 100 cu. ft., the plant being subsequently modified to effect simultaneous dehydration and purification. For this purpose a solution containing 11% monoethanolamine, 72% diethylene glycol, and 17% water was used. The total make-up amounted to 0·13 lb. monoethanolamine and 0·30 lb. diethylene glycol per million cu. ft. of gas, costing 7 cents per million cu. ft. The total treating cost varies from less than 0·5 c. per 1000 cu. ft. for natural gas with a low H_2S content to 2 c. per 1000 cu. ft. for refinery gas of unusually high H_2S content. The presence of CO_2 in the gas also increases the overall cost, owing to its absorption by the ethanolamines. C. L. G.

290.* Apparatus for Study of Pressure–Volume–Temperature Relations of Liquids and Gases. B. H. Sage and W. N. Lacey. *Petrol. Tech.*, November 1939, A.I.M.M.E. Tech. Pub. No. 1127.—An apparatus is described for the measurement of the pressure–volume–temperature relations of pure substances, simple mixtures, and complex mixtures with an over-all absolute uncertainty, which is usually not more than 0·2%. The equipment is suitable for studies in the gaseous, two-phase, and liquid regions. The behaviour of such systems may be investigated at pressures as high as 10,000 lb./in.^{2} for temperatures between 70° and 600° F. The methods of measurement and the construction of the apparatus are described in some detail. G. D. H.

291.* Volumetric Behaviour of *iso*Butane. W. M. Morris, B. H. Sage, and W. N. Lacey. *Petrol. Tech.*, November 1939, A.I.M.M.E. Tech. Pub. No. 1128.—The volumetric behaviour of carefully prepared *iso*butane was investigated over a temperature range of 100–460° F. and at pressures up to 5000 lb./in.^{2} At pressures in the neighbourhood of 700 lb./in.^{2} at 280° F. the actual volume of *iso*butane was only about 20% of that predicted from the perfect gas law, but at pressures over 4500 lb./in.^{2} the specific volume was greater than that predicted from the perfect gas relationship.

The data do not overlap other published information in the gaseous region.

G. D. H.

Cracking.

292.* Reaction Rates in Cracking. W. L. Nelson. *Oil Gas J.*, 26.10.39, **38** (24), 132.—Data on the cracking reaction velocity constants of a series of hydrocarbons and of various petroleum fractions have been correlated to provide a chart showing the variation of this constant with temperature. Most of the data were taken from tests conducted mainly to determine the type of reaction rather than the rate, and it has been necessary to disregard a number of factors for the sake of a generally available correlation. The chart does not indicate the exact products of decomposition, and

should not be used for cracking yields larger than 25%. The effect of pressure is disregarded as being of little significance except in extreme cases. Difficulty is also caused by the fact that decomposition is not the only reaction taking place during cracking, so that material heavier than the charge stock, as well as pure decomposition products, are obtained. The decomposition reaction is defined by the following formula :—$K_1 = \frac{1}{t} \log_e \left(\frac{a}{a-x}\right)$, where K_1 is the reaction velocity constant (yield per second); t is the time in seconds; a is the percentage of material being decomposed that is present in a feed-stock (thus $a = 100$ for a pure feed-stock), and x is the percentage of feed material disappearing in the reaction during time t.

Examples of the use of this chart are provided. C. L. G.

Polymerization.

293.* Polymerization of Hydrocarbons Present in Natural Gas. R. Fussteig. *Petrol. Engr*, October 1939, **11** (1), 219–223.—The various methods available for the polymerization of the lower paraffin hydrocarbons present in natural gas are described. The first stage in the polymerization of these hydrocarbons is dehydrogenation or demethanization to gaseous olefines. The results of the thermal decomposition of individual hydrocarbons are described. Two methods are applied to convert the paraffins into olefines: thermal and catalytic. Catalysts are of two types, one of which effects dehydrogenation and the other demethanization. Detailed processes commercially applied to polymerize hydrocarbons are given, together with flow-sheets. Some of these processes involve polymerization of olefines only, whilst in others decomposition of paraffins to olefines and polymerization of the latter are combined. Catalytic polymerization may be selectively applied—*e.g.*, the butane-butylene fraction of cracked gasoline may be removed by deep stabilization and subjected to polymerization to give di*iso*butylene, which is subsequently hydrogenated to *iso*-octane. R. J. E.

Synthetic Products.

294.* Petrol Synthesis. Temperature Control in the Direct Process. Anon. *Chem. Tr. J.*, 3.11.39, **105**, 347.—Optimum conditions of temperature, rate of throughput, contact time, and pressure for the production of good yields from the synthesis of carbon monoxide and hydrogen are described by the Metalgesellschaft of Frankfort in E.P. 507,366 of 1938. In an example given, gases containing 2 vols. of H_2 to 1 vol. of CO are reacted at 180° C. and normal pressure, the throughput being 1 litre per hr. per gm. of cobalt in the contact mass, the contact time 36 sec., and the heat-load per sq. in. 240 kg.-cals. per hr. A yield of 100 gm. per c.metre of gas was obtained, a similar yield being given on using a chamber twice the capacity and the same amount of catalyst diluted to twice the volume, increasing the throughput to 1·4 litres and the contact time to 51·5 sec., the temperature to 185° C., and reducing the heat load to 168 kg.-cals. A catalyst containing 33% cobalt, 6% thoria, and 61% kieselguhr is used, it being stated that dilution of the catalyst with kieselguhr to a content of 2% cobalt gives a material particularly suitable for the synthesis of lower hydrocarbons from benzine to gasoil. C. L. G.

295.* Hydrocarbon Synthesis from Carbon Monoxide and Hydrogen over Alloyed Catalysts. I. Rapoport and E. Polozhintseva. *Oil Gas J.*, 28.9.39, **38** (20), 52.—The results of investigations of the use of alloyed Ni–Al, Co–Al, and Co–Si catalysts in the synthesis of hydrocarbons from CO and H_2 are presented. The Ni–Al catalysts were prepared in the form of (*a*) lentils and (*b*) powder, a yield of 140 c.c. of hydrocarbons per c.metre being the highest figure obtained when using a lentil Ni–Al catalyst at 170° C. Lower yields were given by the powdered catalyst, by the introduction of NH_3, and by increasing the temperature or the volume velocity. At the same volume velocity it is necessary to use Co–Al (powder) catalyst at a higher temperature (200° C.) in order to attain similar yields, but at half the volume velocity and at 200° C. a yield of 175 c.c. of liquid hydrocarbons per c.metre is obtained. With the Co–Si

catalyst, lower yields (max. 109·6 c.c.) were given even at 220° C., and with much lower volume velocities. This catalyst also appears to give a greater yield of solid paraffins. C. L. G.

298.* Photochemical Reactions under High Pressure. K. Peters. *BrennstChemie*, 1939, **20**, 356–358.—A quartz-mercury lamp was placed in a cylindrical pressure vessel of 50 mm. inside diameter which could be tilted to permit ignition. Lamps were resistant to pressures up to 80 atm., but making lamps for use under several hundred atmospheres would present no difficulties. Preliminary tests were carried out under pressures up to 50 atm. with CO–H, CO–H–NH_3, CO_2–H, CH_4–CO_2, and CH_4–O_2. In all tests where water was either present or formed during the reaction, excessive rust formation of all iron components within the pressure vessel, especially of the finely polished wall, was observed. As aluminium was also subject to corrosion, a silver coat is recommended.

In all tests chemical reactions were observed, although mostly small in extent. With CH_4–O_2 mixtures containing 2–3% O_2, the oxygen was completely consumed after a few minutes' illumination. However, in the reaction gas neither CO nor CO_2 could be found in quantities corresponding to the oxygen volumes consumed. L. R.

297.* Effect of CO–H on Cresol under Pressure. W. Krönig. *BrennstChemie*, 1939, **20**, 355–356.—When *m*-cresol together with CO–H are passed, under 200 atm. pressure at 500° C., over methanol-forming catalysts, the cresol, besides being reduced to hydrocarbons, is also methylated, most probably to trimethylphenol. L. R.

Refining and Refinery Plant.

298.* Use of Gum Inhibitors in Refining of Motor Fuels. W. W. Scheumann. *Oil Gas J.*, 2.11.39, **38** (25), 41.—Modern gum inhibitors have been selected from compounds containing phenolic or primary or secondary aromatic amine groupings, which, in addition to preventing deterioration of the gasoline, have the following characteristics: it should be soluble in gasoline, insoluble or very sparingly soluble in water or NaOH solutions, it should not impart colour to the gasoline, and should be non-reactive with tetraethyl lead or oil-soluble dyes. Those in general use to-day include such materials as the monobenzyl, dibenzyl, *iso*propylmonomethyl, monobutyl and mono*iso*butyl derivatives of *para*-aminophenol, as well as hardwood tar acids.

Gum inhibiting may be coupled with the following treating methods:—

1. Production of end-point and vapour-pressure material directly from the unit and sweetening.
2. Clay-treating end-point material to polymerize only the most unstable constituents and sweetening.
3. Using a light acid treatment on a benzine fraction followed by re-distilling and sweetening.
4. Splitting a benzine fraction into a light and heavy portion, acid-treating and re-distilling the heavy fraction, and sweetening the combined re-distilled heavy gasoline and the light gasoline.

Method 1 is valuable where the equipment is available and where a water-white final colour is not required, as when dyes are used. It is estimated that a possible saving of 3 to 4 cents per barrel of gasoline of a cracked Mid-Continent type can be effected owing to the elimination of the cost of refining, and of the volumetric and octane number loss on treating.

Method No. 2 cheapens the clay treatment by enabling a product of poorer initial colour and induction period to be produced, these characteristics being improved by subsequent inhibiting. Method No. 3 similarly reduces acid costs and volumetric and octane number losses.

Method No. 4 (which is described in detail) represents a saving of 2 cents per brl. of gasoline over the conventional method of acid-treating and re-distillation.

Careful control over sweetening before inhibiting is necessary to prevent any free sulphur lowering the inhibitor susceptibility, and to remove any traces of alkali which

may react with the inhibitor. In these directions processes such as copper-sweetening offer obvious advantages. The relation between improvement in induction period and inhibitor concentration should be studied when deciding on the most effective inhibitor of those available for the particular gasoline to be treated. Figures are given showing the relative costs of inhibiting two gasolines with four different inhibitors, indicating the necessity for careful selection of the inhibitor. C. L. G.

299.* Motor Fuels Refinery is Designed for West Texas Crude. D. H. Stormont. *Oil Gas J.*, 28.9.39, **38** (20), 46.—A description is given of a refinery near Levelland, West Texas, designed to handle West Texas sulphur crude, and consisting essentially of a Dubbs combination topping and cracking unit with a straight-run capacity of 4500 brl. daily and a cracking capacity of 3000 brl. daily. The plant is very flexible and has a high degree of instrumental control.

The crude is settled at 225–250° F. to remove salt, etc., before processing. The cracked gasoline is stabilized and treated with caustic to remove mercaptans, dilute acid to remove nitrogen compounds, dried with activated alumina, and sweetened with copper sulphate and ammonium chloride. A further treatment with zinc sulphide is given to remove any traces of copper, and it is then inhibited with U.O.P. No. 4 inhibitor.

The Slaughter field crude used yields 34·6% gasoline and 9·3% kerosine. The gasoline has an end point of 400° F. distilling 27% to 212° F. and an O.N. of 56·5 and sulphur content of 0·28%; cracking of the reduced crude yields 42% of cracked gasoline. C. L. G.

300.* Distillation Process of Natural Gasoline Extraction. R. W. Machen. *Petrol. Engr*, October 1939, **11** (1), 96–97.—The distillation of natural gasoline has the object of fractionating the rich oil to give the desired gasoline fraction and reducing the oil to as near as possible its original composition for recycling through the absorber. The rich oil passes through heat exchangers into the evaporator, where the bulk of the gasoline plus a small part of the light fractions of the oil are immediately flashed and passed to the bottom of the rectifying column. In the rectifying column the vapours rise from tray to tray in such a manner that intimate contact is obtained at each tray between the rising vapours and descending stream of liquid. The liquid at successive trays becomes richer in lighter components and poorer in heavy constituents, whilst the descending oil becomes heavier and poorer in volatile fractions as it falls to the base of the evaporator, whence it is ultimately returned to the absorbers for recycling. Normal condensation is insufficient to maintain the continuous downward liquid flow, and condensate is introduced at the top of the column as reflux. The quantity of reflux depends on the separation desired and the end-point required for the gasoline. Steam is introduced into the still, the amount depending on the stripping desired. By lowering the partial pressure of the hydrocarbon gases, steam permits the stripping of the heavier gasoline fractions from the oil and increases efficiency by increasing the evaporating surface in the agitation of the oil. R. J. E.

301.* Review of Roumanian Petroleum Refineries. V. Cerchez. *Monit. Petr. roum.*, 1939, **40**, 1061–1065.—This article consists of a very complete review of Roumanian refineries tabulated according to the enterprises operating in the country. Very full details are given of the operation of the major companies during 1938. The refineries are divided into two groups: those with and those without cracking facilities. The former group accounts for about 80% of the industry.

In the following details, all figures relate to annual capacity in tonnes or to throughput or treatment during 1938.

Astra Romana, capacity 2,000,000, treated 1,492,504. These refiners, the biggest in Roumania, possess a battery of twelve crude stills capable of 1,000,000 throughput which are operated to 50% capacity. The tube-stills (McKee system) handled 968,040, or about 97% capacity. The lubricating-oil stills dealt with 75,778 of an 88,000 capaity.

The cracking installation consists of four Dubbs units which operated to about 80% capacity in treating 516,816. The pressure distillate is processed in a Trumble plant.

White spirit, kerosine, etc., are handled by ten agitators, which were kept practically at 100% capacity, but the lubricating-oil refinery plant, which possesses three Laval centrifuges, handled only 35% of its maximum.

The cracked-spirit stabilization plant treated 174,757 and the tetraethyl lead plant 2587. Production of liquefied gas was 2191, of naphthenic acids 504, of bitumen 31,010, and of light petroleum solvents 1005.

A reforming plant is under construction. Storage consists of 334 tanks with a capacity of 424,501 tonnes. There are 1781 employees.

The Romano Americana refinery has a capacity of 1,400,000 and treated 898,054. The crude distillation is dealt with by a Standard-Oil tube system (operating to 80% capacity) and by a battery of eight stills operating to about 50% capacity. The lubricating-oil distillation plant throughput was 23,533, against a maximum of 70,000. The refinery also possesses a Foster Wheeler tube system, which handled 61,000, or a little over 30% of its capacity, and three stills capable of continuous or batch operation which did not operate in 1938. The company also operate a Tube and Tank cracking system which handled 363,952, or 91% of capacity. Kerosine refining is handled by two agitators of 240,000 capacity, which have been used to a little over 50% capacity.

Gasoline is treated in a continuous system, which ran to about 50% of its 200,000 maximum.

Although the distillation plant produced 23,000 of lubricating oil, only 4979 were refined. The lubricating-oil refining plant, which operated to about 11% capacity, consists of two acid and three soda agitators.

Among the miscellaneous equipment of the refinery is an ethyl blending plant and an air-blowing plant for bitumen. 9510 tonnes of bitumen were produced in the year under review.

Storage consists of 149 tanks with a total capacity of 163,957 tonnes. There are 1396 employees. T. C. G. T.

302.* General Review of the Roumanian Petroleum Refineries. V. Cerchez. *Monit. Petr. roum.*, 1939, **40**, 1189–1193.—A further number of Roumanian refineries are reviewed.

The Aquila refinery of the Colombia company has an annual capacity of 540,000 tonnes of crude, which in 1938 treated 285,614 tonnes. The plant consists mainly of a Winkler-Koch tube system coupled with a Winkler-Koch cracking installation. Storage consists of seventy-one tanks with a total capacity of 64,750 tonnes, and the personnel numbers 350.

Creditul Minier de Brazi is the newest refinery in the country, having come into operation in 1935. Its annual capacity is 540,000 tonnes, and in 1938 it handled 389,410. This refinery has a Brunn Konigsfeld tube system and a Dubbs cracking plant. Their storage consists of sixty-one tanks, holding 72,350 tonnes. Personnel amounts to 430.

The Petrol Block refinery Standard de Ploesti has a capacity of 504,000 tonnes. It has a battery of nine continuous stills, which in 1938 treated 126,864 tonnes of their 360,000 capacity. A second battery of seven stills has been idle. The refinery has also a Dubbs cracking plant of 144,000 tonnes capacity, which handled about 53,000 in the year under review. Storage capacity is 82,058 tonnes and personnel 330.
T. C. G. T.

303.* General Review of the Roumanian Petroleum Refineries. V. Cerchez. *Monit. Petr. roum.*, 1939, **40**, 1305–1309.—The extensive review of the Roumanian petroleum refineries in 1938 is continued. In this section the author deals with a group of relatively small refineries which do not possess cracking equipment.

The refineries and their annual capacities and throughputs in 1938 are: Xenia (Ploesti)—capacity 292,000 tonnes, throughput 137,342 tonnes; Dacia Romano, 240,000 and 119,695; Petrolul Bucuresti (Prahova), 210,000 and 187,170; Lumian (Petrolmina) Ploiesti, 150,000 and 41,254.

The average personnel in these installations is about 125 and the storage capacity 30,000 to 50,000 tonnes. T. C. G. T.

304.* Waste Problems in the Petroleum Industry. J. B. Hill. *Industr. Engng Chem.*, 1939, **31** (11), 1361.—This paper describes modern methods for the disposal of waste products in the petroleum industry. H. E. T.

Chemistry and Physics of Petroleum.

305. Rearrangement of Certain Derivatives of Toluene by the Action of Aluminium Chloride. J. F. Norris and H. S. Turner. *J. Amer. chem. Soc.*, 1939, **61**, 2128–2130.—The authors have studied the effect of heating with aluminium chloride in the presence of hydrogen chloride *o*-, *m*-, and *p*-chlorotoluene, *o*-, *m*-, and *p*-nitrotoluene, *p*-cresol, and *p*-dimethylaminotoluene. In some cases the effects of change in time, temperature, and molecular ratio of the aluminium chloride to the organic reactant were studied. They found appreciable rearrangement and disproportionation with the chlorotoluenes, the extent being determined by the conditions under which the reaction proceeded, as mentioned above. Under certain fixed conditions they found that the order of the stabilities of the isomers were *ortho*, *meta*, *para*; and also that the mixture of the isomers obtained from *p*-chlorotoluene consisted of *ortho*, *meta*, and *para* in the ratio 1 : 2 : 1. In the same conditions the isomeric nitrotoluenes and *p*-dimethylaminotoluene were unaffected. It appeared that the *ortho* and *para* directing groups, methyl, hydroxyl, and chlorine, produced in a methyl radical sufficient reactivity to permit a change of position of the latter in the molecule, whereas the *meta* directing nitro-group stabilized the methyl radical so that it did not migrate under the conditions that affect the other class of compounds. R. D. S.

306. Rearrangement of the Xylenes by Aluminium Chloride. J. F. Norris and G. T. Vaala. *J. Amer. chem. Soc.*, 1939, **61**, 2131–2134.—A detailed study of the rearrangement of the xylenes is reported, including investigations into the effects of time, temperature, molecular ratio of hydrocarbon to aluminium chloride, presence of ferric chloride in varying amounts, and presence or absence of hydrogen chloride. Change in temperature affected the ratios in which the isomers were formed, and decrease in the molecular ratio of aluminium chloride decreased the rate of rearrangement and percentage decomposed. The presence of ferric chloride had a negligible effect, and the presence of hydrogen chloride apparently increased decomposition, but did not affect rearrangement. Rearrangement was more rapid than the decomposition of the hydrocarbons and yielded a mixture approaching the composition of commercial xylene. The authors suggest that the results quoted may be employed in the preparation and the elucidation of the structures of compounds obtained by the Friedel-Craft reaction. R. D. S.

307. Oxygen Effect in the Reaction of *cyclo*Propane with Bromine and with Hydrogen Bromide. M. S. Kharasch, M. Z. Fineman, and F. R. Mayo. *J. Amer. chem. Soc.*, 1939, **61**, 2139–2142.—*cyclo*Propane and bromine in the ratio 10 : 1 reacted very slowly even in the light in the absence of oxygen, but the presence of oxygen greatly accelerated the reaction, and organic peroxides exerted a similar catalysis. Ethyl alcohol and *iso*amyl nitrite inhibited the photochemical oxygen-catalysed reaction. Only 1 : 3-dibromopropane was isolated from the reaction as small quantities of reactants were used, but there was evidence that other products were formed. With hydrogen bromide *cyclo*propane was used in tenfold excess, and also in equimolecular proportions. With excess of the hydrocarbon, oxygen tremendously increased the reaction rate, which was otherwise very slow, even in the light. Normal propyl bromide was the product. Benzoyl peroxide again had a similar effect to oxygen, and antioxidants again inhibited the reaction. Oxygen and light, however, had little effect on the reaction between equimolecular proportions of *cyclo*propane and hydrogen bromide, although compounds containing the hydroxyl group accelerated it. For the reaction between *cyclo*propane and bromine, and between excess *cyclo*propane and hydrogen bromide, the authors put forward a chain mechanism in explanation, but consider that the mechanism of the reaction of *cyclo*propane with hydrogen bromide in equimolecular proportions is ionic in character. R. D. S.

308. Chlorinations with Sulphuryl Chloride. I. The Peroxide-Catalysed Chlorination of Hydrocarbons. M. S. Kharasch and H. C. Brown. *J. Amer. chem. Soc.*, 1939, **61**, 2142–2150.—The use of sulphuryl chloride as a chlorinating agent has hitherto depended on the production of molecular chlorine during the reaction, so that there has been little advantage over gaseous chlorine in its employment. The authors have discovered that in the presence of certain catalysts (such as organic peroxides) sulphuryl chloride can serve as a source of atomic chlorine, with the result that they have been enabled to chlorinate in the dark paraffin hydrocarbons, side-chains of aromatic compounds, aliphatic acids, aldehydes, and ketones, etc., far more rapidly and conveniently than is possible by the use of elementary chlorine in the presence of light. The best catalyst was found to be benzoyl peroxide; the less stable lauroyl peroxide was also found to be useful in some cases. The present communication is concerned with the chlorination of hydrocarbons, the results obtained being generally similar to the photochemical chlorination of these compounds by chlorine gas, as the authors found (1) substitution took place on a secondary carbon atom rather than a primary; (2) a second chlorine atom tended to substitute as far from the first chlorine atom as possible; (3) substitution of a second chlorine atom on a carbon atom already holding a halogen substituent was difficult—a third chlorine atom could not be introduced; (4) a bromine substituent was not displaced. In the chlorination of toluene the authors found also that the substitution of chlorine on a carbon atom ceased when the second chlorine atom had been introduced. The chlorination of ethylbenzenes and *iso*propylbenzene occurred chiefly in the alpha position of the side-chain. They were unable to chlorinate diphenylmethane and the nitrotoluenes presumably because of inhibition of the reaction by products of the reaction in the first case, and because of inhibition by the nitro-group in the second case. Complete inhibition was found to be brought about by a number of substances, iodine, sulphur, *p*-nitrotoluene, and oxygen among them. The mechanism of the reaction is considered to be the production of chlorine atoms by a chain reaction initiated by the slow decomposition of the peroxide. R. D. S.

309. Nitrogen Compounds in Petroleum Bases. XV. Counter-Current Extraction of Kero Bases. Isolation of 2 : 4-Dimethyl-8-*n*-Propylquinoline. W. N. Axe and J. R. Bailey. *J. Amer. chem. Soc.*, 1939, **61**, 2609–2612.—A $C_{14}H_{17}N$ base was isolated by fractional degassing of the acid sulphite preliminary to exhaustive counter-current hydrochloric acid extraction of an aromatic kerosine fraction 292–293°. It was identified as 2 : 4-dimethyl-8-*n*-propylquinoline by (1) chromic acid oxidation to 2 : 4-dimethylquinoline-8-dicarboxylic acid, which was identical with an authentic specimen, (2) synthesis from acetylacetone and *o*-*n*-propylaniline. R. D. S.

310. Nitrogen Compounds in Petroleum Distillates. XVI. Use of Multiple Acid Extraction of 2 : 3 : 4-Trimethyl-8-Ethylquinoline. R. A. Glenn and J. R. Bailey. *J. Amer. chem. Soc.*, 1939, **61**, 2612–2613.—Multiple acid extraction of a 305–315° kerosine fraction was used in the isolation of a $C_{14}H_{17}N$ base, the structure of which was identified as 2 : 3 : 4-trimethyl-8-ethylquinoline by chromic acid oxidation to a $C_{12}H_{12}NCOOH$ acid which proved replacement of an ethyl radical by a carboxyl; the 8-position of the ethyl group was shown by the fact that the acid was identical with one previously obtained by chromic acid oxidation of 2 : 3 : 4 : 8-tetramethylquinoline. The structure was confirmed by synthesis from methylacetylacetone and *o*-ethylaniline. R. D. S.

311. Nitrogen Compounds in Petroleum Distillates. XVII. Use of Multiple Acid Extraction in Isolation of 2 : 3 : 4-Trimethyl-8-*n*-Propylquinoline. L. M. Schenck and J. R. Bailey. *J. Amer. chem. Soc.*, 1939, **61**, 2613–2615.—By multiple acid extraction a $C_{15}H_{19}N$ base, b. p. 330°, was isolated from transformer oil and kerosine and identified as 2 : 3 : 4-trimethyl-8-*n*-propylquinoline. Orientation was established by chromic acid oxidation to the same acid as that produced by oxidation of 2 : 3 : 4-trimethyl-8-ethylquinoline reported in the previous communication. The nature of the propyl group was proved by synthesis from methylacetylacetone and *o*-*n*-propylaniline. R. D. S.

312. Peroxide Effect in the Addition of Reagents to Unsaturated Substances. XXII. Addition of Hydrogen Bromide to Trimethylethylene, Styrene, Crotonic Acid, and Ethyl Crotonate. C. Walling, M. S. Kharasch, and F. R. Mayo. *J. Amer. chem. Soc.*, 1939, **61**, 2693–2696.—In the absence of oxygen or peroxides, trimethylethylene adds hydrogen bromide to give *tert.*-amyl bromide, but peroxidic catalysis produces some 64% of 2-methyl-3-bromobutane. The addition of product of hydrogen bromide to styrene is changed from α-phenylethyl bromide with no catalyst to 80% β-phenylethyl bromide with catalyst in solution. However, presence or absence of peroxide always results in the same product of addition of hydrogen bromide to crotonic acid, nor do peroxides catalyse the reaction with ethyl crotonate even in the light. In each case the normal β-bromo-derivative is formed. The authors discuss the various possibilities for this. R. D. S.

313. Hydrogen Fluoride as a Condensing Agent. VIII. The Alkylation of Benzene by Esters. J. H. Simons, S. Archer, and D. I. Randall. *J. Amer. chem. Soc.*, 1939, **61**, 1821–2.—Reactions carried out in a copper bomb at 80–100° showed that in presence of hydrogen fluoride esters react with benzene to produce mainly alkylbenzenes. It was believed that as acids can acylate aromatic compounds in the presence of hydrogen fluoride, ketones would be present in the reaction products, since the liberated acid would react with either benzene or the alkylbenzene present; and expectations were realized in the isolation of ketones in sufficient quantities to permit identification in a number of experiments. Thus, acetophenone was identified from those reactions in which acetates were used. An explanation of the mechanism is proffered, based on ionic processes and supported by experimental results, which indicate it to be a more likely one than an olefinic mechanism previously put forward (McKenna and Sowa, *J. Amer. chem. Soc.*, 1937, **59**, 1204–1205; *J. Inst. Petrol. Tech.*, 1937, **23**, Abstr. No. 1230). *tert.*-Butylbenzene, *iso*propylbenzene and diphenylmethane were formed from benzene and the acetates. *n*-Butyl acetate and *sec.*-butyl-*iso*butyrate both gave *sec.*-butylbenzene. R. D. S.

314. Reaction of Propene with *iso*Olefins in the Presence of Sulphuric Acid. V. N. Ipatieff, H. Pines, and B. S. Friedman. *J. Amer. chem. Soc.*, 1939, **61**, 1825–1826.—Although propene alone was not responsive to polymerization by 96% sulphuric acid, when mixed with more reactive olefins such as (i) *iso*butene, or (ii) *iso*pentenes, and then contacted with the acid, it yielded, among other products, (i) 8–35% heptenes, and (ii) 16% octenes and 17% tridecenes, respectively, the percentages varying according to the conditions. The heptenes were then hydrogenated to mostly 2 : 2-dimethylpentane, 2 : 3-dimethylpentane, and some 2 : 2 : 3-trimethylbutane, which heptanes were identified by physical constants and Raman spectra analysis. With straight-chain olefins such as *n*-butene scarcely any of the propene reacted to form liquid hydrocarbons when contacted with sulphuric acid. R. D. S.

315. Dehydration of *trans*-2-Methyl*cyclo*Hexanol. C. Price. *J. Amer. chem. Soc.*, 1939, **61**, 1847–1849.—By the dehydration of *trans*-2-methyl*cyclo*hexanol with phosphoric anhydride a mixture of 1-methyl-1-*cyclo*hexene and 3-methyl-1-*cyclo*hexene was formed, which on hydrogenation gave a methyl*cyclo*hexane no different from authentic samples of this hydrocarbon. This investigation, therefore, could not confirm a report (Vogel, *J. chem. Soc.*, 1938, 1323–1338; *J. Inst. Petr. Tech.*, 1938, **24**, Abstr. No. 1429) that the methyl*cyclo*hexane formed by the above method was of different physical properties from the genuine hydrocarbon. R. D. S.

316. Heats of Organic Reactions. VIII. Some Further Hydrogenations, including those of some Acetylenes. J. B. Conn, G. B. Kistiakowsky, and E. A. Smith. *J. Amer. chem. Soc.*, 1939, **61**, 1868–1876.—This paper is the last of the series, and the discussion includes a survey of the results of previous communications on this subject. Heats of hydrogenation of cyclic hydrocarbons, cyclic ketones, and acetylenic compound have been measured. The rather large variation in the *cyclo*-olefin series is claimed to be due to interactions of the newly formed bonds with non-bonded atoms and atomic groups in the proximity. As the cyclic ketones show a trend similar in

manner to that of the *cyclo*-olefins, and the acetylenes, likewise, are similar to the ethylenes in the variation of the heats of hydrogenation with substitution of the alkyl groups, further evidence is obtained that the variation in the heats of addition reactions are principally caused by the steric effects of substituents on the addenda used in the reactions. In an attempt to evaluate the character and magnitude of the effects, the authors, from observations on ethane, come to the conclusion that the positions of minimum energy are those in which the C–H bonds are farther apart—that is to say, the configuration is staggered. The greater stability of this structure is ascribed to the existence of repulsive interactions—steric hindrance—between non-bonded atoms in the polyatomic molecules, and these repulsive interactions result in inconstancy of bond energies. The relative magnitude of steric hindrance is assumed to be substantially affected only by substitutions on the same atoms to which the bonds considered belong. The effect of hindrance of internal rotation is believed to be due to steric hindrance and not to an independent mechanism. Accordingly, the authors emphasize the importance of steric hindrance in regard to the effects of substituents upon "standard" properties of functional groups in polyatomic molecules, regarding it as next to resonance in this respect. R. D. S.

317. Internal Rotation and Resonance in Hydrocarbons. E. Gorin, J. Walter, and H. Eyring. *J. Amer. chem. Soc.*, 1939, **61**, 1876–1886.—The restricted rotation of the methyl groups about the C–C bond in ethane is due, according to recent experimental evidence, to the existence of a potential barrier of the order of 3000 cal., but the repulsion due to the hydrogen atoms cannot account for this. The authors calculate what the barrier height would be if the hydrogen atoms were replaced by protons, and discuss the lack of cylindricity of the C–C bond due to the presence of the methyl hydrogen atoms. This effect adds to the stability of the opposed configuration, and allowing for the effect of resonance involving double bond structures (the opposed structure can be reasonably considered stable), the required barrier height is obtained. The authors also make use of the effect of resonance with double-bonded structures to explain the alteration in physical properties, and conclude with a discussion on the evidence available by X-ray, infra-red, and Raman spectra studies concerning the relative stabilities of staggered and opposed configurations for long-chain and cyclic compounds. R. D. S.

318. Validity of the Structure Assigned to *cyclo*-Octatetrene: Pyrolysis of *bis*-Quaternary Ammonium Hydroxides Related to 1 : 2- and 2 : 3-Butenes. C. D. Hurd and L. R. Drake. *J. Amer. chem. Soc.*, 1939, **61**, 1943–1945.—The structure of 1 : 3 : 5 : 7-*cyclo*-octatetrene was formulated by Willstätter and Waser as a result of experiments on the pyrolysis of the *bis*-quaternary ammonium hydroxide. The argument of the present authors is that conjugated double bonds need not necessarily have been produced exclusively in the reaction; for pyrolysis of 1 : 2-butane-*bis*-(trimethylammonium) hydroxide gave rise to ethylacetylene and methylallene but no 1 : 3-butadiene, and pyrolysis of 2 : 3-butane-*bis*-(trimethylammonium) hydroxide gave 1 : 3-butadiene and methylallene or (methylallene + dimethylacetylene), the latter being slightly in excess of the 1 : 3-butadiene. That 1 : 3-butadiene was not the sole product from the second reaction (as would be required by conjugated unsaturation in *cyclo*-octatetrene) leads the authors seriously to doubt the Willstätter structure. R. D. S.

319. Reaction of Olefins with Solid Cuprous Halides. E. R. Gilliland, J. E. Seebold, J. R. FitzHugh, and P. S. Morgan. *J. Amer. chem. Soc.*, 1939, **61**, 1960–1962.—Ethylene, propylene, and *iso*butylene were found to be absorbed by solid cuprous chloride, the first-named also being absorbed by solid cuprous bromide, from which the authors infer that the reaction is typical of olefins and the cuprous halides. The olefins were absorbed by the halides mole for mole, except in the case of *iso*butylene, where complete saturation was not obtained, as, presumably, equilibrium was not reached. It was found that olefins may be recovered from gaseous or liquid mixtures by absorption with cuprous halides, and the authors give a method based on the fugacity data of Lewis, by which the theoretical maximum recovery may be calculated. R. D. S.

320. Effect of Substitution on the Dissociation of Hexa-arylethanes. VII. *meta*- and *para*-Phenyl Groups. C. S. Marvel, M. B. Mueller, and E. Ginsberg. *J. Amer. chem. Soc.*, 1939, **61**, 2008–2010.—The authors prepared the tetraphenyl-di-*m*-biphenylethane, and found by measurement of its magnetic susceptibility that it is dissociated to the extent of 11–12% in a 3·6% solution of the ethane in benzene at 25°, and in the same way found that the *p*-biphenyl derivative exists to the extent of 13–14% as the free radical under the same conditions. They concluded that the number of resonance forms of the free radical must play a rather minor rôle in determining the degree of dissociation of these hexa-arylethanes. They found, further, that the depth of colour of a free radical solution is not a reliable guide to the degree of dissociation, being merely partly characteristic of the groups present and their positions. R. D. S.

321. Synthesis of *tert.*-Butyl- and *tert.*-Amyl-*cyclo*pentane and of their Intermediate Products. H. Pines and V. N. Ipatieff. *J. Amer. chem. Soc.*, 1939, **61**, 2728–2730.—The method consists of cyclizing the appropriate alkyladipic acid to alkyl*cyclo*pentanone, which is then hydrogenated catalytically to 3-*tert.*-alkyl*cyclo*pentanol. The carbinols are next dehydrated by the use of aluminium oxide to the olefins, which on hydrogenation give *tert.*-butyl- and *tert.*-amyl-*cyclo*pentane. R. D. S.

322. The Redistribution Reaction. I. The Random Intermolecular Exchange of Organic Radicals. G. Calingaert and H. A. Beatty. *J. Amer. chem. Soc.*, 1939, **61**, 2748–2754.—A new type of reaction, which the authors propose to call "The Redistribution Reaction," has been recognized. The process is one in which all the radicals or atoms of one kind, linked to one or more central groups or atoms of another kind, are interchanged (during a reaction occurring in a mixture of such compounds) between all the various central groups present. As the final composition of any system of this kind can be calculated from the laws of probability, the interchange must happen at random, hence the term "Random Equilibrium Mixture" applied by the authors to the reaction products. Although this introductory paper considers the exchange of radicals in organo-metallic halides and in metal alkyls, the authors stress the fact that the redistribution reaction is not confined to this field. The first reaction studied was that between tetraethyl-lead and triethyl-lead chloride, the tetraethyl-lead containing radioactive lead (Radium D). After a short time at room temperature both the tetraethyl-lead and the triethyl-lead chloride showed the same intensity of radio-activity. A repetition of the experiment was performed with the alkyl group in the alkyl-lead different from that in the alkyl-lead halide; here all the five possible tetra-alkyl-leads and all the four possible trialkyl-lead chlorides were formed. The reactions between the two different metal alkyls were studied. The authors found that, employing various catalysts, the reaction proceeded smoothly between the compounds containing the same or different alkyl groups and the same or different metals, with no decomposition, side reactions, evolution of gas, precipitation of metal, or heat of reaction. The system was found to reach a state of constant composition, beyond which it could not proceed and containing all the possible metal alkyl compounds in equilibrium. The authors have applied the laws of probability to these random equilibrium mixtures and have confirmed their findings experimentally. They consider the mechanism of the redistribution reaction to proceed through the formation of co-ordination compounds with the catalyst, and observe that the reaction has possibilities for investigations in the nature and behaviour of covalent bonds as well as for organic synthesis. R. D. S.

323. The Redistribution Reaction. II. The Analysis of Metal Alkyl Mixtures and the Confirmation of Random Distribution. G. Calingaert, H. A. Beatty, and H. R. Neal. *J. Amer. chem. Soc.*, 1939, **61**, 2755–2758.—This paper describes how the analyses of the volatile metal alkyl mixtures were carried out by distillation correct to less than 1%, and how the analyses of a series of mixtures which had suffered the redistribution reaction agreed with the predicted compositions. R. D. S.

324. The Redistribution Reaction. III. Determination of a Material Balance. G. Calingaert and H. Soroos. *J. Amer. chem. Soc.*, 1939, **61**, 2758–2760.—The redistri-

bution reaction was shown to be quantitative in nature by the determination of an accurate material balance for a reaction involving a mixture of tetramethyl- and tetraethyl-lead in hexane solution. It was found that the use of aluminium chloride as catalyst resulted in the formation of only very small quantities of alkyl-lead compounds, whilst with methyl aluminium chlorides the amount of alkyl-lead compounds formed was negligible. R. D. S.

325. Effect of Substitution on the Dissociation of Hexa-arylethanes. VIII. The Disproportionation of Tri-*p*-Tolymethyl. C. S. Marvel, W. H. Rieger, and M. B. Mueller. *J. Amer. chem. Soc.*, 1939, **61**, 2769–2771.—Magnetic susceptibility measurements showed that hexa-*p*-tolylmethane in fresh benzene solution is dissociated to the extent of 16 ± 2% in 0·08 molar concentration at 30°, although if the solution is allowed to stand for a few hours at room temperature the colour disappears, and a new determination shows that the free radical is no longer present, but a polymeric material remains. The authors suggest a mechanism for the disproportionation based on that of tri-*p*-tolylmethyl, which, in benzene solution, rapidly forms tri-*p*-tolylmethane and a quinoid polymeric residue. The same polymer seemed to be produced by the removal of hydrogen chloride from tri-*p*-tolylmethylchloride by the action of pyridine. R. D. S.

326. The Disproportionation of Hexa-*p*-Alkylphenylethanes and the Effect of *ortho*-, *meta*-, and *para*-Alkyl Groups on Dissociation of Hexa-arylethanes. C. S. Marvel, M. B. Mueller, C. M. Himel, and J. F. Kaplan. *J. Amer. chem. Soc.*, 1939, **61**, 2771–2775.—In the ninth communication on the effect of alkyl groups on the dissociation of hexa-arylethanes the authors report that those hexa-*p*-alkylphenylethanes in which there is a hydrogen atom on the α-carbon atom of the alkyl group dissociate to free radicals which undergo disproportionation. They found that the effect of the various *p*-alkyl groups on the degree of dissociation (17–33%) was greater than expected (2–6%), and varied according to the shape and size of the alkyl group. They also found that the *ortho*- and *meta*-methyl groups, due partly to steric effects, were more active than a *para*-methyl group in promoting dissociation and gave relatively stable radicals. Di-*p*-alkylphenyltetraphenylethanes were found to be more highly dissociated than hexaphenylethane and to disproportionate less readily than the corresponding hexa-alkyl derivatives. R. D. S.

327. Hydrogenation of Substituted Acetylenes with Raney Nickel. K. N. Campbell and M. J. O'Connor. *J. Amer. chem. Soc.*, 1939, **61**, 2897–2900.—Using Raney nickel as a catalyst, the authors have reduced mono- and di-substituted acetylenes, the course of the reaction being shown to depend on the symmetry of the molecule. At the half-reduction stage certain new olefins were obtained from some of the dialkylacetylenes, and the authors suggest that the use of Raney nickel, which seems to act catalytically like palladium, but is easier to use, affords a convenient method for making olefins by half reduction and saturated hydrocarbons by full reduction. R. D. S.

328. Fluorocarbons. The Reaction of Fluorine with Carbon. J. H. Simons and L. P. Block. *J. Amer. chem. Soc.*, 1939, **61**, 2962–2966.—The properties of six compounds in addition to a 25–160° boiling-range mixture prepared by a continuous non-explosive reaction between fluorine and carbon are described. R. D. S.

329. Benzoylformic Acid from Styrene. C. D. Hurd, R. W. McNamee, and F. O. Green. *J. Amer. chem. Soc.*, 1939, **61**, 2979–2980.—An account is given of the oxidation of styrene (phenylethylene) to benzoylformic acid by potassium permanganate. R. D. S.

330.* Phase Equilibria in Hydrocarbon Systems: The Methane–Ethane System in the Gaseous Region. B. H. Sage and W. N. Lacey. *Industr. Engng Chem.*, 1939, **31** (12), 1497.—The specific volumes of five mixtures of methane and ethane were determined at 70, 100, 130, 160, 190, 220, and 250° F., and pressures up to 4750 lb. per sq. in. The results are presented in tabular form. The partial volumetric behaviour of

methane and ethane in the system has been calculated, and from these data and published information the partial thermodynamic behaviour of the components has been calculated over the range of conditions given above, and presented in graphical and tabular form. P. D.

331.* Halogenation of Hydrocarbons. H. P. A. Groll and G. Hearne. *Industr. Engng Chem.*, 1939, **31** (12), 1530.—Olefines containing a double bond in an unbranched carbon chain react with halogens at elevated operating temperatures to give a product which is almost exclusively of the substitution type. The substitution occurs in the olefine with the almost exclusive formation of allyl-type unsaturated monohalides. The optimum temperature range for this reaction is 300–600° C., and depends on the nature of the reacting olefine and halogen. Operating conditions and yields have been carefully examined in some detail, and although at present the exact mechanism of the reaction is obscure, the data presented will prove useful as a basis for the study of the kinetics of the reaction. The main section of this valuable paper is concerned with the chlorination of propylene at elevated temperatures, and the various factors affecting the reaction have been investigated in considerable detail. The corresponding bromination of propylene has only been attempted for a few isolated cases.
H. E. T.

332.* Viscosity Index.—Thomas. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 891–896.—Several graphical methods have been proposed for expressing the change in viscosity of an oil with temperature. A number of these graphs are reproduced and discussed. The relation of viscosity–temperature characteristics to cold starting, oil consumption, etc., is demonstrated. Suitable increase in viscosity index should enable the same oil to be used throughout the year. W. P.

333.* Viscosity Index Chart for Kinematic Viscosities. F. H. Garner and E. W. Hardeman. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 897–899.—Absolute units are now more generally used for expressing viscosity of lubricating oils. Using the Dean and Davis formula for viscosity index, the authors have constructed a viscosity index chart for kinematic viscosities using viscosities determined at 50° C. and 100° C.
W. P.

334.* Graphs for Determination of Viscosity Index. M. Roegiers. *Proc. IIme Congrès mond. Pétrole*, 1937, **2** (2), 901–904.—The Dean and Davis method of deriving viscosity-index based on Saybolt viscosities at 210° F. and 100° F. is limited in its application to America, since neither the Saybolt nor the particular reference temperatures are normally used in Europe. Graphs are given which enable the viscosity index to be determined from viscosities at 20° C. and 100° C. (Continental) or 70° F. and 100° F. (English). W. P.

335.* Viscosity Index Independent of Temperature of Measurement. F. P. Malschaert. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 905–910.—Viscosity–temperature characteristics have been represented by two systems: (*a*) in which log log (centistokes + 0·8) is plotted against log *T*, *e.g.* the Viscosity Pole-height system, (*b*) in which the viscosities at two temperatures are related to viscosities of standard oils, *e.g.*, Dean and Davis system. The advantages and disadvantages of the two systems are discussed. The author proposes an Independent Viscosity Index, I.V.I. $= 100 \times \frac{L - X}{L - H}$, where *L*, *H*, and *X* are log log (centistokes + 0·8), relating respectively to 0KVI, 100KVI and unknown oils.

The advantages claimed are: (1) ease of plotting, (2) extrapolation beyond 0 and 100, (3) application to mixtures, (4) change of base oils possible, (5) similarity of I.V.I. and K.V.I. within region 0–100. W. P.

336.* Nomograms for Expression of Viscosity of Lubricating Oils. J. Groff. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 911–915.—The logarithmic graphs derived

from the A.S.T.M. formula have been converted into nomograms with scales in various conventional units. W. P.

337.* Viscosity–Temperature Curve of Lubricating Oils. L. Steiner. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 925–931.—Viscosity curves have been prepared for a number of oils from determinations of viscosity with a Steiner viscometer between 20° C. and 100° C. Results were examined for conformity with the formula log log $(V + a) = A - B \log T$. It is concluded :—

(1) That the formula holds sufficiently accurately between 20° C. and 100° C. for normal practical purposes, and that the divergence between actual and theoretical is the same for all oils.

(2) That the value of a is not constant, but lies between 0·6 and 1·2, with an average of 0·8.

(3) That if the fixed points are accurately calculated, extrapolated values are lower, and interpolated values higher than actual with an average error of $\pm$ 5%. W. P.

338.* Viscosity–Temperature Relationships of Hydrocarbons. E. B. Evans. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 933–954.—The viscosities of ninety-three hydrocarbons are given in centipoises at 0°, 20°, 50°, 80°, and 100° C. These data are applied to a discussion of various viscosity–temperature relationships, and it is concluded that the A.S.T.M. equation, a modified Andrade–Silverman equation, and a modified Batschinski equation are of outstanding interest, since they are capable of representing accurately a wide range of data and there is considerable theoretical justification for the last two. W. P.

339.* Viscosity of Pure Hydrocarbons. W. R. Van Wijk and J. M. Versteeg. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 955–959.—The viscosity of a number of pure hydrocarbons has been determined with a view to studying the viscosity–temperature and viscosity–density characteristics in relation to structure. Normal hydrocarbons from C_5 to C_{14} have approximately equal viscosities at equal densities (within 5%). In general the viscosity of branched-chain hydrocarbons is greater than that of the normal series, but in some cases the reverse is true. For normal series the viscosity, considered as a function of density, appears to pass through a minimum in the neighbourhood of C_9. W. P.

340.* Logarithmic Relation Between Viscosity and Temperature. G. Juge-Boirard. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 961–971.—Viscosity–temperature formulæ from Poiseuille to Walther are criticized as attempting to introduce a constant or constants of universal application. The author deduces a simple linear logarithmic relation between viscosity and temperature

$$\log \eta_t = a \log \frac{t + c}{t_1 + c} + \log \eta_{t_1}$$

in which c is a constant particular to the material in question and calculable from viscosity data determined at three fixed temperatures.

The equation can be adapted to any temperature scale. W. P.

341.* Viscosity–Temperature Relationship. E. L. Lederer. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 973–979.—The "Steilheitsgefälle N" is defined as the second differential of viscosity with respect to temperature, and a formula is derived relating it to absolute temperature. The thermodynamical basis of the formula and its relation to chemical constitution are discussed in comparison with other systems, such as that of "Pole-height." W. P.

342.* Constitution in Relation to Viscosity of Mixtures. A. Bondi. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 987–989.—A consideration of the theoretical consequences

of the Arrhenius formula for the viscosity of mixtures leads to the evaluation of the magnitude and temperature susceptibility of the "Solvation factor" in the Lederer formula. Their relation to chemical constitution is shown by viscosity measurements on a number of oils and oil mixtures. W. P.

343. Catalytic Dehydrogenation of Mono-Olefines to Diolefines. A. V. Grosse, J. C. Morrell, and J. M. Mavity. *Symposium on Plastics and Resins from Hydrocarbons. Amer. chem. Soc. Meeting, Boston*, September 1939, pp. 53–61.—A previous paper has described the catalytic dehydrogenation of gaseous paraffins to mono-olefines. The same process using the same catalysts can be applied for the dehydrogenation of olefines to diolefines when products of the conjugated type with the same C framework as the parent olefines are formed.

Olefines the C frameworks of which do not permit the introduction of conjugated double bonds yield under these conditions hydrogen and carbonaceous material.

In these experiments the charge was passed at a definite rate through a section of granular catalyst in a quartz tube maintained at a constant controlled temperature. The catalysts in general were of the chromium, molybdenum, or vanadium oxide-on-alumina type. The diolefines formed were identified by the preparation of crystalline derivatives, either the maleic anhydride addition compounds, the tetrabromides, or both.

The once-through yields of the diolefines under the conditions used in these experiments varied from 20% to 30%, but it is possible that these do not represent optimum conditions.

Carbon formation in the dehydrogenation of olefines is considerably higher than in the dehydrogenation of paraffins.

The particular diolefines prepared in this work were butadiene-1 : 3 from *n*-butylenes, isoprene from branched-chain pentenes, and piperylene from pentene-2. It is pointed out that the production of cheap butadiene and isoprene is of great importance in the development of the synthetic rubber industry. D. L. S.

344. Action of Boron Halides on Hydrocarbons. R. F. Ruthruff. *Symposium on Plastics and Resins from Hydrocarbons. Amer. chem. Soc. Meeting, Boston*, September 1939, pp. 63–91.—Considerable attention has been given to reactions catalysed by aluminium chloride, but analogous work employing the boron halides has been comparatively meagre.

Boron halides are usually more active than the aluminium halides, and the reactions induced are more clean-cut and less masked by side reactions. The preparation and properties of the four halides are described, boron fluoride being dealt with in more detail than the other three.

The greater part of the paper then discusses the action of boron fluoride on olefinic hydrocarbons, a short paragraph only dealing with the effect of the other three halides.

Boron fluoride has little action on the paraffin hydrocarbons alone, although in the presence of olefines some of these substances are alkylated. The effect of this catalyst on the polymerization of olefines is described in some detail and the work of numerous investigators is discussed.

Conditions for polymerizing ethylene, propylene, butylenes, amylenes, and many other olefines are given. The low-temperature polymerization of *iso*butylene and other *iso*-olefines yields products of a resinous or rubber-like type which find numerous applications in industry.

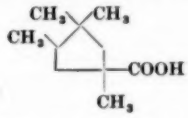
In general the activity of the catalyst is improved by the use of a promoter, and finely divided nickel, hydrogen fluoride, hydrogen chloride, and organic halides are amongst the materials used for this purpose.

An attempt to deal with the olefine–boron fluoride complexes formed in these reactions from the standpoint of electronic structure is made. D. L. S.

345. Solid Naphthenic Acid from Iranian Petroleum. T. Kennedy. *Nature*, 11th November, 1939, **144**, 832.—It is only comparatively recently that individual naphthenic acids have been isolated in a pure state, many which had previously been reported as pure having subsequently proved to be mixtures.

Examination of the SO_2 extract from an Iranian kerosine revealed unexpectedly

the presence of approximately 0·025% of naphthenic acids, of which about 10% was removed by a light caustic washing. The spent caustic washings from 2000 gals. extract were neutralized and the precipitated oil was worked up in the usual manner. From the acidic material the tertiary acids were separated, and these, on standing for a few days, yielded a white crystalline solid which analysis showed to have an empirical formula $C_{10}H_{18}O_2$. A total yield of 3·3% of this acid was obtained on the original acid mixture from the caustic washing-liquors. The compound was proved to be saturated, and must therefore contain a closed carbon ring, the following structure being suggested



Since this work was completed the isolation of a solid tertiary naphthenic acid, m. p. 194–194·5° C., from a Californian straight-run gasoline distillate has been described by other workers. D. L. S.

348.* New Catalytic Syntheses of Hydrocarbons. V. N. Ipatieff. *Monit. Pétr. roum.*, 1939, **40**, 1433–1438.—Recent developments in alkylation, cyclization, and polymerization are reviewed. The elements of the structural changes during these syntheses are presented. T. C. G. T.

Analysis and Testing.

347.* Means of Measuring Turbidity and Fluorescence Using the Lovibond Tintometer Fitted with the Rothamsted Device. G. S. Fawcett and J. Hewitt. *J. Soc. chem. Ind.*, 1939, **58**, 342–344.—A special cell, termed a nephelometer cell, has been developed for the Lovibond–Schofield apparatus, which latter is a modification of the Lovibond tintometer. Using the nephelometer cell, turbidities of colourless liquids can be measured easily in quantities ranging from 0 to 100 parts of fuller's earth per 100,000 parts of water.

The cell is placed at the back of the artificial light cabinet, and a piece of polished black glass is placed behind and in contact with the cell. Light from the lamps passes through the cell at 45°, and the light scattered by the particles in the liquid illuminates one field of the eye-piece. The other field is illuminated by light reflected from a magnesium carbonate block, and the brightness of the field is adjusted until it matches that of the other. The brightness of varying degree is obtained by Schofield's rotating vane.

The cell may also be utilized for the measurement of fluorescence. In this case the fluorescent liquid is diluted to remove if possible the predominating colour of the liquid, but to retain the fluorescence. The fluorescent colour is matched by colour-slides. T. C. G. T.

348.* Laboratory Method for Evaluating the Influence of Lubricating Oils on Carbon Deposition. H. A. Everett and G. H. Kaller. *Engineering*, 1939, **148**, 676.—Two types of small, single-cylinder, air-cooled engines were used to evaluate the carbon-forming tendencies of different lubricating oils. In order to eliminate the inevitable variables of slight differences in engine performance from run to run, and to eliminate the effect of progressive wear during a series of tests, six engines of each type were used, and the tests carried out so that each engine ran alternately on the reference oil and the test oil. The various oils were tested in each of the six units of both types of engine. The carbon built up on the cylinder heads was determined at intervals of 8, 16, 24, 32, and 40 hr. of operation by weighing the head and replacing without removing the carbon. At the end of 40 hr. the pistons were weighed to determine the build-up on the piston. The total oil consumption was also measured and the carbon deposited in the combustion space expressed as the *specific carbon* (weight of carbon deposited divided by weight of oil consumed). The specific carbon value for an oil divided by the specific carbon of the reference oil gives the *carbon ratio*. It is

shown that for the five oils examined the carbon ratios as determined in either type of test engine were in good agreement with the carbon ratios obtained on full-sized six-cylinder automobile engines. J. W. H.

349.* Errors in the Calibration of Secondary Viscometers. A. Gangloff. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 887–889.—A description of improvements in the methods and apparatus used for the calibration of absolute viscometers. The calibration involves determination of constants h and K in the expression $\eta = K(H - ha)t$; h being back pressure due to liquid, H suction, a specific gravity, and t time of flow. For the determination of h two runs are made, one with suction H, one under action of gravity. For the determination of K a series of standard reference viscometers is used. Errors of earlier methods are discussed, and thermostatically controlled apparatus is described capable of an accuracy of $\pm$ 0·005° C. W. P.

350.* Flow of Oil at Low Temperatures. S. Erk. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 917–923.—The ability of an oil to flow at low temperatures is important from the point of view both of cold starting and of the maintenance of adequate lubrication. Conventional methods of testing for flow at low temperatures are criticized, in that they do not take into account all the practical requirements. Microscopic investigation shows that the "cold point" coincides with the commencement of crystallization of wax and that flow under mechanical forces is due to the break-up of the crystal skeleton. In this condition the oil flows, but its viscosity is dependent on the rate of shear. True evaluation of an oil at low temperatures necessitates determination of flow and viscosity in relation both to temperature and to rate of shear. W. P.

351.* Apparatus for Testing Lubricants and Bearing Metals. J. Prevost. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 1011–1016.—The Vollet machine consists essentially of a free-running ring inserted between two discs which are fixed to concentric shafts whereby they can be rotated. The lubricant under test is fed on to the ring which tends to be entrained by the rotating discs, and the couple exerted can be determined.

A mathematical analysis of the machine is given and a number of results quoted. The machine can be used for tests on lubricants or on bearing metals. W. P.

352.* Nomograms for Expressing Results of Mechanical Tests on Lubricants and Bearing Metals. J. Prevost. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 1017–1020.—Mechanical tests of lubricants generally permit only comparative results. The interpretation of such results can be facilitated by graphical presentation, and a nomogram is given based on results achieved with the Vollet machine, but of a type applicable to other tests. W. P.

Motor Fuels.

353.* Development of Anti-knock Motor Fuel Part 2. A. W. Trusty. *Petrol. Engr*, October 1939, **11** (1), 34–36.—Two general methods are available for improving the anti-knock qualities of motor fuel: (1) addition of a chemical, (2) changing the hydrocarbon structure of a gasoline. Of chemicals added, tetraethyl lead is the most widely used. Safety regulations to ensure that the handling of this poisonous compound is not dangerous to the health of the operator are described. The inclusion of ethylene bromide in the fluid provides bromine to convert the lead into lead bromide which is sufficiently volatile to pass out of the cylinder with the exhaust gases. Iron and nickel carbonyls are effective as anti-knock dopes, but have not been commercially developed to the same extent as tetraethyl lead. The usefulness of benzol and alcohol as anti-knock compounds is illustrated by a tabulation of their properties in comparison with those of a typical gasoline. High anti-knock gasoline can also be produced by solvent extraction of selected fractions. Results obtained with sulphur dioxide are illustrated.

The maximum octane number gasoline that can be practicably produced by liquid

phase cracking is about 70. Higher anti-knock gasolines are obtained by developments of cracking, viz. reformation, alkylation, polymerization, and hydrogenation. Reformation is used to convert a low octane s.r. gasoline into a high octane fuel. Alkylation consists of the combination of an olefine with a paraffin in the presence of concentrated sulphuric acid to give a branch-chain paraffin. By segregation of suitable hydrocarbons, fuels with an octane number of 90–100 can be produced by this process. Paraffin dehydrogenation is effected by the use of alumina catalyst activated by metallic oxides and salts. Dehydrogenation of propane and butane followed by polymerization and hydrogenation gives high anti-knock *iso*-paraffins. Aromatic hydrocarbons can be formed by polymerization of olefinic gases, but, although high in anti-knock value, these hydrocarbons have the disadvantage of a poor lead response. The polymerization process has been operated either with phosphoric acid as catalyst at relatively low temperatures and pressures or at high temperatures and pressures without catalyst. Both methods yield a polymer gasoline with a blending value of about 120 octane number. R. J. E.

354. Hydrogen as a Substitute Fuel for Otto Engines. M. Oehmichen. *Automobiltech. Z.*, 1939 (42), 573–576.—When an emergency arises in a country in which there is a shortage of liquid fuels, the possibility of the use of hydrogen as a substitute fuel for Otto engines is invariably reconsidered. During the last war and afterwards a great deal of research work was done in Germany by Erren, and a company formed to store the surplus energy of the big power-stations in the form of hydrogen formed by the electrolysis of water, and to use it in motor-cars and industrial power-stations. Difficulties in the use of hydrogen are to be found in the fact that it strongly attacks all iron, and especially valves, so that a sleeve-valve engine of special design has to be used. Moreover, hydrogen gives far too quick a combustion. It has therefore been proposed to mix it with inert gases before entering the cylinders. The author summarizes all available data on the subject, and concludes that the fundamental principles of the question still need elucidating. E. W. S.

Diesel Fuels.

355.* Improving Diesel Fuels by Blending with Fischer–Tropsch Synthesis Products. H. Kölbel. *BrennstChemie*, 1939, **20**, 352–355, 365–369.—Kogasin II produced by the Fischer–Tropsch synthesis would permit a considerable reduction of the compression ratio (to 1 : 11 or 1 : 10), but it is too expensive to be used alone, and its extremely short ignition delay would prohibit its use in present-day C.I. engines. Also, its high freezing point, combined with paraffin-wax crystal formation commencing at about 2° C., are a disadvantage, whilst dewaxing is not feasible. Suitable fuels can, however, be prepared when Kogasin II is blended with low-ignition-quality aromatic tar oils or hydrogenated oils. The percentage of Kogasin II added varies, according to the ignition quality of the poorer component, between 40% and 55%, and the fuel blends obtained have cetene numbers between 65 and 85. Blends with unrefined tar oils cannot be stored and are not suitable for engine use. For such oils special methods of refining have been developed. The chemical properties and engine behaviour of a series of fuel blends containing coal-tar oil, internal-suction tar oil, and coal-hydrogenation oil, respectively, which had been produced according to these methods, partly in large-scale experiments, and partly in large production plants, are examined in detail. These blended fuels are thoroughly equal to petroleum products. They have a high ignition quality, a high resistance to carbon formation, and an extremely good combustion. L. R.

356.* Production of Vegetable Fatty Oils in France—Soya-Bean Oil. A. B. d'Ollivier. *Rev. Comb. liq.* (August–September), 1939 (167), 225–235.—In a discussion on the cultivation of the soya bean in France, reference is made to the value of the oil as a diesel engine fuel. Experiments carried out in 1933 by the South Manchurian Railway at a temperature of − 18° to − 25° C. proved conclusively its suitability as fuel for heavy oil engines. It was particularly noted that starting was effected without any pre-heating.

The following table gives a comparative analysis between French and Manchurian soya-bean oil.

	French soya-bean oil.	Manchurian soya-bean oil.
Density at 15° C.	0·933	0·920
Acidity as oleic	0·22%	0·15%
Calorific value	9392	9340
Flash point	314° C	—
Viscosity Engler at		
10° C.	14·13	—
15° C.	—	6·1
20° C.	8·78	—
35° C.	—	4·5
50° C.	3·18	—
55° C.	—	2·7

Research work has been carried out at Clermont-Ferrand with a diesel motor, using soya and peanut oils as fuels, gas oil having a cetene value of 65 being used for comparison.

The motor was a four-stroke two-cylinder type, having a preheating chamber, a bore of 126 mm., a stroke of 180 mm., and working at 1140 r.p.m. The engine was not modified in any way, except by the provision of a small electric heater in order to reduce the viscosity of the oils under test by bringing them to a temperature between 55° and 60° C.

Comparative consumption tests were carried out at full, ¾, and ½ loads, and a table is given showing the results, these being in all cases somewhat higher than for gas oil for both soya and peanut oils, the former showing the highest consumption in gm./h.p./hr.

Using the vegetable oils it was not found possible to attain the same h.p. as with gas oil, but this is explained by the fact that the injection pump was not set correctly, and consequently the oil delivery was insufficient. In view of the fact that no exhaust fumes were observed in the above tests, it is suggested that by increasing the oil delivery, the output attained with gas oil could have been reached. Exhaust gases analysis showed that an output of 32·2 h.p. was attained with the same mixture strength for the three fuels, this being about 0·65. Starting was found to be quite satisfactory for all three fuels, a torch of special paper being used as a hot spot. An examination of the engine after each test showed no abnormal deposit on the injector, valves, or any other parts of the engine.

These first tests have proved conclusively that the diesel motor under test gave a satisfactory performance using soya and peanut oils as fuels, but in view of the fact that the engine used is particularly suitable for use with a variety of fuels (relatively slow speeds and preheating chamber), and that the small quantity of fuels available was not sufficient for exhaustive tests, it is suggested that further work should be carried out on a greater variety of engines, particularly of the industrial types, before a thorough study of lorry motors is attempted. M. M. L.

Lubricants and Lubrication.

357.* Properties of Mineral Lubricating Oils. — Freund. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 981–986.—In previous publications the author has shown certain relationships between viscosity, density, boiling point, molecular weight, etc. To investigate whether these same relationships held good for oils prepared by newer methods, *e.g.*, solvent extraction, hydrogenation, etc., the author has examined a number of high-class commercial oils of low specific gravity manufactured by different processes. In general, the relationships formerly established were found still to hold good, except in the case of synthetic oils. W. P.

358.* Improved Lubricants and Lubrication. B. H. Lincoln and G. D. Byrkit. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 991–1001.—The general theory of lubrication is discussed, and the results of X-ray and other investigations into film structure and film thickness are reviewed.

Super refining, although improving viscosity–temperature and other characteristics of oils, removes those polar bodies to which " oiliness " is due. Selection of suitable

additives can be made by preliminary laboratory investigation followed by service tests. The results of laboratory investigation of a number of additives using the Timken Wear Test and the Almen Wear Test are given. W. P.

359.* **The Molecular Theory of Lubrication.** O. Wittrock. *Proc. IIme Congrès mond. Pétrole*, 1938, **2** (2), 1003–1009.—Experimental confirmation of the hitherto purely theoretical hydro-dynamic theory of lubrication has been attempted. Assuming perfect metal surfaces, a formula can be readily deduced for liquid friction on this hypothesis. An apparatus is described for the experimental investigation of the formula. A film of lubricant is observed between two circular metal surfaces formed by the ends of two cylinders, one of which can be rotated. The pressure on the film can be regulated and the film thickness measured optically.

It is concluded that it is necessary to modify the formula to take into account the nature of the metal surfaces, and that in boundary friction the effect of the physical state of the metal surfaces is normally greatly in excess of that of the molecular structure of the oil. W. P.

360.* **Used Lubricating Oil Recovery.** A. T. Wilford. *Petroleum*, December 1939, **1** (2), 41.—A discussion is presented of methods of recovery of used lubricating oil, based on experience of the London Passenger Transport Board.

Of the lubricants used in motor vehicles only the engine oil and oil from pre-selective gear-boxes is regarded as suitable for recovery, that from clash gear-boxes and rear axles being too small in quantity and very much oxidized in service, whilst that from fluid flywheels is not worth recovery. It is estimated that at a consumption of 1 gal. per 1000 miles, the ratio of oil available for recovery to total used is 5 : 11 if crankcases are drained every 6000 miles, or 5 : 17 if drained every 12,000. Pre-selective gear-boxes provide a maximum of 1¾ gal. after 6000 miles running which it is not always profitable to recover, as there are few purposes for which it could be used, except possibly as fuel. Continuous purification *in situ* using felt, cotton waste, or filter clay is frequently used on goods and passenger vehicles, the type using replaceable cartons being regarded as the most efficient, although much more expensive to maintain. The clay type are claimed to remove asphaltic and acidic bodies, but this shortens their useful life, and may lead to the absorption of any inhibitors present in the oil.

Crank-cases of petrol engines of the L.P.T.B. are drained every 12,000 miles and re-filled with a mixture of fresh oil and 10% of used oil. With high-speed oil-engines of the indirect injection type, oil is drained after 12,000 miles, and with those of the direct-injection type after 6000 miles; in neither case is the oil used again.

Figures are given showing typical characteristics of used oils from petrol and high-speed oil-engines and from pre-selective gear-boxes, indicating the much higher hard asphalt content of the oil from petrol engines than that from oil engines, owing to its being of a lower grade, whilst the carbon is in a less finely divided condition.

Methods of recovery of such oils are described. Centrifuging is used for lightly contaminated oils from large diesel engines and batteries of engine-test stands; coagulation of carbon in used oil from petrol engines is effected by mixing with 1–2% of an alkali, agitation and heating by steam, and separating the oil and centrifuging, followed by further mixing with water and centrifuging. Final heating of the oil removed the last traces of diluent and left the oil suitable for re-use. Owing to the formation of emulsions, oils from C.I. engines could not be satisfactorily treated by this method.

Edge filtration through paper discs removes suspended matter, but only partly reduces asphaltic or acidic compounds. Some improvement is effected by increasing the temperature of the oil and using filter aid. C.I. engine oil is difficult to reclaim by this method, but pre-selective gear-box oil is normally recovered by it and re-used once, although it is inferior in oxidation resistance to the original oil. Another type of filter, consisting of pairs of papers impregnated with kieselguhr crimped at the edges and separated at the centres by ¼-in. washers, is claimed to be suitable for C.I. engine oil.

Impurities from used petrol-engine oils can also be removed by floating it over a large surface of water containing a coagulant such as trisodium phosphate, which slowly rises through the oil through electrical heating. On cooling, the water settles, taking the impurities with it.

Mixing the heated oil with absorbent clays is capable of treating used C.I.-engine oil, yielding oils closely resembling the fresh oil.

Distillation followed by sulphuric-acid treatment, clay treatment, and filtration requires careful handling, and is suitable only where large quantities of oil are available. Yields of recovered oil vary from 80% to 95%, whilst the cost may approach 1*s.* per gallon. It is emphasized that spectacular economies cannot be expected, although small definite savings are being effected, and the present conditions suggest the extension of such work. It is suggested that the best and most economical method is for the oil to be re-run in refineries handling crude oil. C. L. G.

361.* Recent Developments in Diesel Lubricating Oils. G. L. Neely. *J. Soc. Aut. Engrs.* 1939, **45** (5), 485–500.—The author contends that lubrication is an element of machine design; suitably compounded diesel lubricants are justified, inasmuch as they allow engine performance to be extended to a higher level than is possible with straight mineral oils. The paper describes the development of a new compounded diesel lubricating oil; the base stock used is a specially treated naphthenic-base oil. The necessary development work involved prolonged tests on five makes of engines using eight sets of test conditions; loads ranged from 2·5% to 150% of rated power and jacket temperatures from 80° F. to 375° F. The results given in the paper are confined to four compounded oils and one straight mineral oil.

The use of compounded oils led to a marked reduction of piston deposits and ring-sticking, but many addition agents caused corrosion of non-babbitt bearings. Extensive research resulted in the development of a non-corrosive lubricant which gave excellent results in a prolonged ring-sticking test. The same compounded oil showed a low rate of cylinder wear under both high- and low-temperature operating conditions; in comparison, the straight mineral oil permitted much greater wear, whilst some other compounded oils were not uniformly satisfactory at all temperatures.

Fundamental investigation shows that conventional oils tend to spread from hot to cold surfaces with a measurable force which varies with the temperature. An apparatus has been built for the study of "limiting adhesion temperature," and a correlation established between this characteristic of an oil and cylinder wear. It is believed that the piston-ring temperatures in many diesel and aircraft engines exceed the limiting adhesion temperatures of oils commonly used. The wear studies have shown that measurable differences exist between different lubricants in respect of ring-groove as well as cylinder wear. The former is important, since worn grooves allow oil-pumping and excessive blowby. Severe breaking-in tests resulted in scuffing of rings and pistons when a normal oil was used, whereas a compounded oil was quite satisfactory.

Anti-ring-sticking agents may be either oxidation catalysts or oxidation inhibitors. Both types may prevent ring-sticking, but the catalysts decrease the oxidation stability of the base, causing filter clogging and corrosion. A suitably compounded oil promotes filter cleanliness. The life of a compounded lubricant is dependent on the rate at which the compounding material is consumed. When regular oil changes were eliminated, auxiliary filters of the clay or Fuller's-earth type showed no advantage. The frequency of oil-changing should be determined in practice by operating conditions. Over an extended period of service oil consumption is primarily dependent on: (1) degree of freedom of the rings; (2) amount of carbon found in the oil-ring slots; (3) piston-ring wear; and (4) the surface condition of rings and liners. For this reason a compounded lubricant may prove more economical than a straight mineral oil costing less per gallon.

Diesel lubricants containing anti-ring-sticking agents may be employed to free piston-rings and remove piston-deposits that have been caused by previous use of unsuitable oils. This "purging" effect results in the gummy and carbonaceous materials which are removed from the pistons becoming suspended in the oil. Attention must therefore be given to the filters during initial operation with a "purging" oil.

The author claims that a compounded diesel lubricant is now available having all of the following properties: (1) anti-ring-sticking value; (2) non-corrosivity; (3) low wear at both high and low temperatures; (4) good breaking-in properties, and (5) high stability in both storage and service. K. T. A.

See also Abstract Nos. 348, 351.

Detonation and Engines.

362. Sound- and Pressure-Waves in Detonation. C. E. Grinstead. *J. Aeronaut. Sci.*, 1939, **6** (10), 412–417.—This paper presents studies of the relationship between the frequency of pressure-waves in the combustion chamber and the audible sound in air produced by detonation. Three engines were investigated: a two-stroke o.h.v. diesel, a modified "L" head Delco gasoline engine, and a variable-compression knock-testing gasoline engine. Sound and pressure waves were picked up with a microphone and carbon-stack indicator, respectively, and recorded by simultaneously photographing the screens of two cathode-ray oscillographs. The microphone was located in several different positions to find the point of maximum sound intensity.

Some of the records are reproduced, and it is shown that there is a one-to-one correspondence between the frequency of the shock-waves in the combustion chamber and the frequency of the audible sound in air. On the Delco engine the frequency of the shock-waves was increased from 3100 to 3415 c.p.s. by the addition of oxygen; it was found that there was a corresponding change in the sound frequency. Other interesting features of the records are discussed. K. A.

363.* Pumpless Injection. Anon. *Auto. Engr*, 1939, **29**, 331.—A short description of a new type of diesel engine developed in Germany by the late Dr. Ing. Prosper L'Orange which has been successfully demonstrated as a 2000-c.c. two-stroke and also as small two-stroke and four-stroke engines having swept volumes from 100 to 300 c.c. The system employs the pressure differential between the main combustion space in the cylinder and an antechamber.

On the suction stroke fuel is admitted to a delivery channel by a mechanically operated valve. This channel is situated in an inserted block forming the throat between the combustion space and the antechamber. Small exit channels lead from the delivery channel to each side of the restricted throat. A thermally isolated heat-storage member is provided in the antechamber and a heater plug is fitted for starting purposes. The pressure difference between the ends of the two exit channels carries the fuel from the delivery channel to the antechamber and the main combustion space at different stages of the working cycle. During the compression stroke fuel is forced into the antechamber, but when combustion commences in the antechamber, with a consequent rise in pressure, the fuel flow is reversed, and the remaining fuel is delivered into the main combustion space. Tests were made on a 300-c.c. four-stroke engine developing 4 B.H.P. at 2400 r.p.m. equivalent to a B.M.E.P. of approximately 73 lb. per sq. in. Operating on a compression ratio of 19–1, the fuel consumption at the above power output was 0·5–0·55 lb. per B.H.P./hr. It is stated that a small 100-c.c. air-cooled two-stroke engine has been operated successfully up to 5000 r.p.m. C. H. S.

364.* Italian Multi-fuel Engine. Anon. *Auto. Engr*, 1939, **29**, 358–360.—A description of a new type of engine now being fitted to the Fiat tractor which has been patented by Professor Boghetto.

The engine is of the injection type, with a comparatively low compression ratio of 7·2–1. It is fitted with high-tension ignition, and its main working characteristic is that it takes a full air charge at all loads up to one-sixth of the maximum load, and therefore its consumption at low loads follows the same consumption law as that of the diesel engine.

The basic principle of this engine is the stratification of the fuel mixture in a chamber which may be considered as separate from the power cylinder. This combustion chamber is so placed that it is not subject to the influence of the passage of suction air or exhaust gases, and it remains full of burnt gases at the end of the suction stroke. Fuel is injected into the combustion chamber in the direction of the mouth of the chamber, where it meets air coming from the cylinder and produces a homogeneous explosive mixture without any artificially created turbulence. The sparking-plug situated practically at the upper limit of the carburated air zone provides ignition as in an ordinary carburation engine. Data are given which show the performance of the engine on gas oil and 93° alcohol. On gas oil the consumption figures are comparable with those of a good diesel engine. The lowest specific consumption is obtained

at ¾ load, and at ½ and ¼ load the consumptions are respectively 19% and 42% higher than that at full load. C. H. S.

365.* French Multi-fuel Engine. Anon. *Auto. Engr*, 1939, **29**, 369–370.—A description of the Brandt–Bagnulo engine and Brandt–Bagnulo cylinder-head which can be supplied for converting existing Ford, Fordson, Citroen, Latil, and other French engines to this system. The efficiency of the diesel engine is claimed, combined with the light weight, flexibility, simplicity, and ease of maintenance of a petrol engine. It has the outstanding advantage of functioning either on gas or on light and heavy liquid fuels.

In the head-casting there is provided for each cylinder a special antechamber in which carburation, gasification, and the initial combustion of the fuel take place. The antechamber is in open communication with the working cylinder by means of a tangential passage. Fuel and air from a jet-type mixing device are admitted to the antechamber by a supplementary valve actuated through a relay lever from the normal inlet-valve rocker. The mixing device has two constant-level float-chambers to permit the use of two fuels, either separately or simultaneously. On the suction stroke fuel enters the antechamber simultaneously with the admission of pure air to the working cylinder. The fuel is drawn from the constant-level chamber and vaporized by a current of air from a diffuser as it leaves the jet. It then traverses heated conduits and enters the antechamber by the supplementary valve, and is directed towards a heated tongue in the vicinity of the sparking-plug, and is thus gasified before being mixed with air from the working cylinder. In this manner the spark always occurs in a highly explosive mixture, irrespective of the quantity of fuel introduced. For the Brandt–Bagnulo engine with a compression of 9–1 it is claimed a petrol consumption of approximately 0·44 lb. per H.P./hr. can be maintained at all normal working loads. C. H. S.

366.* Combustion. H. Rabezzana, S. Kalmar and A. Candelise. *Auto. Engr*, 1939, **29** (389), 347–353 (390), 377–381.—Combustion phenomena have been studied in L-head engines; pressure development and flame movement were simultaneously recorded by photographing oscillograph diagrams. Pressure–time records were obtained by means of a carbon-stack element, and flame records by the ionization-gap method. The results have been analysed mathematically by a step-by-step method. Briefly, this consists of burning a volume increment at constant volume and expanding the same into the already-burned and still-unburned portion of the mixture, until pressure equilibrium is reached. An example of this analytical method is given.

Records obtained from various combustion chambers and under various operating conditions are analysed to show the effect of different variables. It is shown that the duration of the entire combustion cycle, depending mainly on the reaction velocity, controls the peak pressure and also detonation. From the experimental results it appears that the initial stage of combustion is the most sensitive to the effects of the various factors governing the reaction velocity; consequently it is the logical point of attack for efforts to produce a more stable and faster-burning mixture—*i.e.*, less stratification and more turbulence in the vicinity of the spark plug at the instant of ignition. K. A.

367.* Trends in Design of 1940 Cars. T. A. Bissell. *J. Soc. Auto. Engrs*, 1939, **45** (5), 457–470.—A survey of engineering improvements in American cars for 1940. Progress is most marked in the transmission field, the most interesting development being the Oldsmobile four-speed automatic gear-box embodying a fluid flywheel. Auxiliary over-drive gears are available on a number of cars.

Engine compression ratios are still rising, 6·5 : 1 being quite common. Many carburation systems have been modified to give increased power; larger fuel pumps and insulated fuel lines have made their appearance. The general tendency is to increase engine powers by taking full advantage of the most recent improvements in fuels. K. A.

Economics and Statistics.

368.* Transport of Roumanian Oil by the Danube. Anon. *Rev. Petrolifère*, 29.9.39 (856), 1201; 28.10.39 (860), 1269.—95% of the petroleum products which are exported from Roumania by the Danube route are loaded at Giurgiu from storage reservoirs into tankers. Giurgiu is 900 miles from Vienna and 1170 miles from Regensburg in Bavaria. At the outbreak of war the Danube tanker fleet comprised 298 vessels, with a total capacity of 201,315 tonnes. This capacity has recently been increased by 20,000 tonnes. Germany owned 45% of this total capacity. Prior to July 1939 the greater part of German imports from Roumania were transported by sea from Constanza. The following statistics are given:

Exports of petroleum products from Roumania.

	1938. tonnes.	1939 (Jan.–June). tonnes.
By sea from Constanza		
To Germany and Austria	558,857	270,963
To Czechoslovakia	nil	121,083
	558,857	392,046
By Danube Route		
To Germany and Austria	134,407	157,750
To Czechoslovakia	294,898	131,029
	429,305	288,779

The round trip from Giurgiu to Germany and back, possible during nine months of the year only, takes five weeks. But this is dependent on appropriate storage or railway transport being available at the ports of loading and discharging. If these conditions were fulfilled, and the German tanker fleet was increased to 160,000 tonnes capacity, it might be possible for Germany to import 1,300,000 tonnes annually by the Danube route.

Some years ago, Russian oil, unloaded at Sulina on the Black Sea, was also transhipped to Danube tankers and imported by this route to Central Europe.

S. J. A.

369.* Pre-War Expansion in German Motor Traffic. Anon. *Petroleum Press Service*, 8.12.39, **6**, 47, 571.—During the twelve months ended 1st July, 1939, motor vehicles registered in Germany exceeded those of the previous twelve months by about 16%. The following figures are given:

	1938.	1939.
Private cars	1,305,608	1,486,451
Goods vehicles	400,288	442,036
Omnibuses	20,792	23,302
Motor-cycles	1,582,872	1,860,722
Tractors	54,943	82,077
	3,364,503	3,894,588

These figures include vehicles in use in Austria. If the vehicles registered in Czechoslovakia are added, it is estimated that Germany can draw upon over 4 million vehicles.

S. J. A.

370.* Production and Circulation of Automobiles Throughout the World. Anon. *Monit. Petr. roum.*, 1939, **40**, 1471–1476.—This article is a mass of statistics for the year 1938. Every country is tabulated, with the number of automobiles registered,

manufactured, and exported; the population and persons per vehicle; the length of the road systems, and the consumption of motor spirits. The greater part of the figures appear to have been extracted from the annual publication of the American Automobile Manufacturers Association, *Automobile Facts and Figures*.

In 1938 in the U.S.A. there were 29,490,728 vehicles, or 1 to every 4 persons. Great Britain had 2,422,675 vehicles, with 20 people per vehicle, whilst the figures for other countries were: France 2,233,500 automobiles, 19 people per vehicle; Germany 1,753,600 and 45; Italy 469,400 and 92; Roumania 35,500 and 563; Russia 672,952 and 251; Japan 180,800 and 395; Australia 799,750 and 9; South Africa 349,631 and 28; and China 45,196 and 9,957. The greatest number of people per vehicle is found in Liberia.

A few examples of the length of roads in kilometres are: U.S.A. 4,937,477; U.S.S.R. 2,706,513; Japan 1,070,619; France 633,561; Germany 416,364; and Great Britain 308,130.

In 1938, 4,001,566 automobiles were produced, 62·2% by U.S.A., 11·2% by Great Britain, 8·8% by Germany, 5·3% each by France and Italy, and 4·1% by U.S.S.R.

89,909,000 tonnes of motor spirit and 8,500,000 tonnes of lubricating oil were consumed by automobiles throughout the world. T. C. G. T.

371.* Statistics on the Personnel of the (Roumanian) Petroleum Industry. Anon. *Monit. Petr. roum.*, 1939, **40**, 1297–1301.—The personnel of the Rumanian petroleum industry in 1938 has been analysed and tabulated according to occupation, employers and location.

31,600 people are employed in the industry, 49·7% in the field and 25% in refineries. Of the major companies, Astra Romana head the table, employing 6352 people, 46·9% in the field and 28% in refineries. For Steaua Romano, the figures are respectively 4048, 63·4% and 24·5%; Concordia 3426, 49·8% and 26·3%, Unirea 3323, 40·2% and 17%; Romano-Americana 2890, 36·5% and 48·3%. It is also of interest to note that Petrol Block employed 399 people in 1938, 80·9% being in refineries.

The total of 15,700 employed in the field compares with 18,430 in 1937, whilst there has also been a drop from 8200 in 1937 to 7900 in 1938 in the refinery employment. T. C. G. T.

372.* Production of Crude Oil in Venezuela in March 1939. Anon. *Rev. del Min. Fomento* (*Venezuela*), June 1939, II (13), 616–623.—Total production in March 1939 from the oil-fields of Venezuela amounted to 2,323,149·926 metric tons, showing an increase of 121,407·435 metric tons over the preceding February. This difference is due to the smaller number of days in that month. The actual daily outputs for the two months were 74,940 metric tons in March and 78,632 metric tons in February, showing a difference of 3693 metric tons in favour of the latter month.

Compared with March 1938, this year's output shows an increase of 89,416·765 metric tons, this being due to the outputs of three new fields, at Bachaquero, Temblador, and Oficina.

Total export in March by the oil companies was 2,262,111·148 metric tons.

During this month seven of the leading companies refined 127,395·894 metric tons.

New Wells. Twenty-two were started up: twenty-eight came into production, thirty-three were in process of being drilled.

In addition to the above, a number of trial borings were made in the Eastern region of Venezuela. These reached depths up to 3000 metres approximately. Out of ten wells, one reached the production stage at 1841 metres and one was abandoned. Drilling continues in the remainder.

In the Central region one well is being sunk, and in the Western region one well has reached a depth of 2641 metres, and samples are being obtained. H. I. L.

373. Particulars of Oil Concessions in the State of Monagas, Venezuela. Anon. *Rev. del Min. de Fomento* (*Venezuela*), July 1939, II (14), 129–130, August 1939, II (15), 381–382, September 1939, II (16), 531–532.—Tables are given showing all essential particulars of the oil concessions granted in the State of Monagas since the commencement of production, including the names of the concessionaire, the area of the fields, and the duty paid thereon. Earliest demands for concessions were made in 1929.

Growth of Production.—A graph is shown giving the growth of production in Venezuela from nothing in 1917 up to 2,680,000 metric tons in July 1939. H. I. L.

374. Argentine Petroleum Industry (Action taken by the Republic). M. L. Villa. *Bol. Inform. Petroleras*, October 1939, XVI (182), 5–66.—A fully detailed historical and statistical review of the development of the Argentine petroleum industry as operated by the Government since its inception, showing the great progress made by the setting up of the Y.P.F., whose aim is to develop the resources of the country for the benefit of the community as a whole, as opposed to the work of private concerns. Figures given are eloquent of the success of the scheme, which was initiated in 1910. The article is well illustrated and interesting graphs are given. H. I. L.

375. Petroleum in Venezuela. Anon. *Bol. Inform. Petroleras*, October 1939, XVI (182), 67–87.—An account of the present position, with statistics, of the petroleum industry in Venezuela. In 1938 production reached the considerable figure of 27 million metric tons. In spite of this, there is urgent need for financial reform. Most of the oil is exported, and production is in the hands of big American and European companies. The Government appear to be desirous of emulating the action of the Argentine Republic, but whereas the latter country is capable of consuming their entire output, conditions are reversed in Venezuela. H. I. L.

376. World Petroleum Legislation. Anon. *Bol. Inform. Petroleras*, October 1939, XVI (182), 88–97.—The notes on World Legislation on Petroleum, which have appeared regularly since No. 174 of this journal, are of particular interest in the present number, as they deal exclusively with Mexico. The course of the graph (p. 89) showing the annual production from 1901 to 1938 is of peculiar interest. H. I. L.

BOOK REVIEWS

Recent Marine Sediments. A symposium edited by P. D. Trask. Pp. 736, 137 figures. Published by the American Association of Petroleum Geologists, Tulsa, Oklahoma, U.S.A.; London, Thomas Murby and Co. Price $5.

Sediments are of pre-eminent interest to oil geologists, and it is therefore appropriate that "Recent Marine Sediments" should be published by the American Association of Petroleum Geologists. However, its appeal is not limited to oil geologists.

Some years ago the Committee on Sedimentation, under the direction of W. H. Twenhofel, sponsored a Treatise on Sedimentation which dealt comprehensively with both recent and ancient sediments. The new symposium is intended as a supplement to the Treatise. Its various articles have been contributed by American, European, and Japanese authors, and cover a wide range of subjects. These are grouped under the following headings: transportation; the relationship of oceanography to sedimentation; deposits associated with the strand line; near-shore sediments—hemipelagic deposits; pelagic deposits; special features of sediments; methods of study. In addition to descriptions of the distribution of various types of sediments, information is given on the physical processes in the ocean, rates of sedimentation, the occurrence and activity of bacteria in marine sediments, the organic content of recent marine sediments, the properties of clays, faecal pellets in relation to marine deposits, mechanical, mineralogical and X-ray analyses, bottom-sampling apparatus, and the presentation of sedimentary data.

Each paper is the work of a specialist, who has summarized the progress in his particular field, and since some subjects are discussed by more than one author, different explanations are offered for certain phenomena.

Palæogeographical considerations are becoming more and more important in the search for oil, and consequently all data derived from a study of recent marine sediments which facilitate the interpretation of ancient sediments are especially welcome. Furthermore, the studies have a bearing on the perennial problem of the origin of oil. The physical geologist, too, will find much of interest in this volume, and some papers may well be read by the petrologist and geochemist.

Extensive and up-to-date as is the information presented, much of the value of this symposium lies in its being a key to a wide range of literature on the different topics, for each paper is rounded off with a list of selected references. The accessibility of the contents of the symposium is made very easy by a subject index sixty-two pages in length.

G. D. Hobson.

A Practical Manual of Chemical Engineering. By Harold Tongue, M.I.Mech.E., Mem.A.S.M.E., A.M.I.Chem.E., with a foreword by Sir Gilbert Morgan, O.B.E., D.Sc., Sc.D., LL.D., F.R.S. Pp. xv + 560. Chapman & Hall, Ltd., London. Price 36*s*.

The object of a text-book dealing with any branch of engineering is generally to present the fundamental scientific principles and to indicate how these principles are applied and can be applied in practice. This desirable combination is not always achieved. The scientific principles may be well set out without it being clear to the reader how they can be utilized to advantage in dealing with practical problems. On the other hand, books which emphasize the practical aspect often take the form of collections of tables and data or descriptions of plant in ordinary use. Although valuable in their sphere, such books fail to bring out the principles by which practice is, or should be, guided. Judged by these criteria, Mr. Tongue's book has attained a high standard. In it the principles underlying chemical engineering operations are treated on similar lines to those which have been established by the pioneer

American text-books in this field, though naturally not in the same detail; the practical aspects of these operations are emphasized to a greater degree without losing sight of the basic principles.

Materials of construction, both metallic and non-metallic, which are such an important subject in chemical engineering practice, are dealt with at some length. This section, which also contains much useful information on methods of fabrication, occupies about a third of the book. The other chapters deal with the design and construction of pressure vessels, pipes and pipework, heat insulation, steam plant for chemical works, fluid flow, heat transfer, evaporation, drying, adsorption, distillation, filtration, crushing and grinding, and pumping. The field is a wide one, and Mr. Tongue has covered it well. His book will be of great value to those whose work is concerned with chemical engineering. A. J. V. UNDERWOOD.

The Cracking Art in 1938. U.O.P. Booklet 239, edited by Gustav Egloff with the co-operation of Mmes. Crandal, Doty, and Jordan and Messrs. Dryer, Johnstone and Hulla, indexed by Mme. Laetz. Pp. 458. Universal Oil Products Co., Chicago.

The petroleum industry is very familiar with the information and up-to-date brochures sponsored by the Universal Oil Products Co. and edited by our distinguished American member, Gustav Egloff.

The present volume is a stupendous achievement, and it illustrates in an astonishing fashion the vast volume of research poured out in the short span of one year on the outstanding problem of the up-grading of mineral oil.

For that is the real objective before the industry. Natural oil from the well is woefully unfitted for our modern purposes. At every stage its fractions, once admittedly suitable and sufficient for the demands of civilized men, are found to be crude, ill-balanced, immature, incomplete, and in point of fact needing drastic revision.

And so we can contemplate the time when our familiar crude oil will be split up into chemical bricks from which we can fashion the special structure we need, be it gasoline, fuel, or lubricant. Although this time has not quite arrived, Egloff's summary of progress in one short year indicates that it is on the way.

The volume before us details most of the outstanding achievements of 1938: the development of catalytic cracking; the development of the so-called "midget" polymerization unit; the development of *iso*-octane units involving a double catalysis; the outstanding development of alkylation units which produce *iso*-octane and its homologues from the straight combination of *iso*-paraffins and olefines; the development of new methods of refining and the greater use of anti-oxidants.

Egloff stresses the immediate importance of catalytic cracking combined with the decomposition of the inherent heavy residue. He emphasizes the vast importance of research on the chemistry and physics and thermodynamics of the gaseous hydrocarbons, and indicates how, from these sources, new chemical "bricks" may be produced for synthetic purposes.

To give even a brief and inadequate summary of this most valuable publication would be a task of great difficulty, but the chapter-headings will perhaps suffice:—Statistics—catalytic research on cracking—pyrolytic research on cracking—electrical methods of research—survey of commercial cracking operation—equipment for cracking plant, tubes, furnaces and heat exchangers—corrosion—treatment of cracked products—inhibitors—by-products, alcohols, glycols, esters, halides, sulphides, etc., from cracked gases and a general discussion on the production of high-octane aviation fuel by means of polymerization, alkylation, dehydrogenation, ring closure, and hydrogenation.

The work finishes with a thoroughly comprehensive abstract of the patent literature, produced, as all the petroleum world knows, with the meticulous care and accuracy that characterize the library service at Riverside. Your reviewer, with many happy memories of this great research station, of Dr. Egloff and his associate, Prof. Ipatieff, and the staffs of the laboratory and the library, wishes to take this opportunity of thanking them for a great contribution to our knowledge.

A. E. DUNSTAN.

Modern Road Emulsions. By F. H. Garner (Editor), L. G. Gabriel and H. J. Prentice. 2nd Edition, 1939. Pp. xv + 245. The Road Emulsion and Cold Bituminous Roads Association Ltd., London. Price 10*s*.

This book started as a series of lectures to road engineers. These lectures were expanded and published as a book in 1933: there now appears a second edition, in which previous omissions have been made good and additions and modifications necessitated by increased knowledge and experience have been made.

Those closely conversant with the subject will find the book rather elementary, but those who seek to know the essentials of the subject and to receive practical advice will find it here, pleasantly set out. The style of writing is simple, and the illustrations are adequate and interesting, although some have been seen some time ago.

Roughly, the first half of the book is concerned with the road emulsions and their uses, whilst the second portion includes tests and specifications, British and foreign. There are two appendices on the Determination of the Size-Frequency Curve of Emulsion Particles, and Average Diameter of Particles; a Glossary of Terms, an excellent Bibliography, and a collection of twenty-six Tables of great practical interest.

The "get-up" of the volume makes it more of a "book" than was the first edition, and in all aspects it is a pleasant technical companion on one's shelf.

P. E. SPIELMANN.

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Geology.

377.* Permian Redbeds of Kansas. G. H. Norton. *Bull. Amer. Ass. Petrol. Geol.*, **23**, 1939, 1751–1819.—An account of further detailed work on the Permian redbeds of Kansas is given with reference to Cragin's type sections and classification. With few important changes his classification is still used, after 40 years, as a satisfactory basis for the subdivisions of the Cimarron redbeds.

The present paper reports certain new facts discovered and describes in detail individual rock units of the redbed sequence. Combined surface and subsurface cross-sections show the mutual relationships of these beds and their correlations with equivalent strata in Colorado and Oklahoma.

The main conclusions reached are :—

(1) The Harper Sandstones (of Cragin), which include an important dolomite–anhydrite–salt series, has been restricted, with the exclusion of the lower formations—viz., the Ninnescah Shale and the Stone Corral dolomite–anhydrite.

(2) The most important and definitely recognizable units of the Cimarron redbeds (1732 ft.) are the three dolomite–anhydrite formations, Stone Corral, Blaine-Dog Creek, and the Day Creek. Regional correlations can be made confidently on these. Intervening and variable red sandstones and shales occur between the Stone Corral and the Blaine, and for these the name Nippewalla has been introduced.

(3) There is but little evidence of a major unconformity in the Kansas redbeds. Local unconformity may be present just above and below the dolomite–anhydrite formations, but most of the irregularities result from lateral gradation or slumpage.

(4) The Blaine-Dog Creek may be considered one formation in Kansas, each varying in thickness and dependent on the presence or absence of soluble gypsum deposits. The gypsum bed in Cragin's Jenkins clay, formally uncorrelated and unnamed, receives the name Nescatunga.

(5) The Marlow and Relay Creek dolomite members of the Whitehorse are thought to be present in Kansas. Cloud Chief gypsums are unknown, and thus the upper Whitehorse may be equivalent to the Rush Springs member.

In addition to sections the paper contains many photographs. G. S. S.

378.* Development of the Geological Studies Undertaken in the Gulf of San Jorge. A. Rossbach. *Bol. Inform. Petroleras*, November 1939, XVI (183), 27–42.—This account is the story of Comodoro Rivadavia. Oil was discovered here in 1907, as a result of borings which had been undertaken along the coast, with the object of finding water for the growing Patagonian villages. The search for water failed, but in exchange an important oilfield was located. The article is well illustrated with plans and sections. H. I. L.

379.* Control of Albanian Oilfields Ensures 4% of Italy's Crude Requirements. Anon. *World Petrol.*, May 1939, **10** (5), 26–27.—In 1938 Albania's oil output was 72,166 tons. Although concessions have been granted to various interests, the Italians alone have carried out much work. They hold concessions in the coastal zone, Vojussa or intermediate zone and the interior or Devoli zone. In 1925 wells were drilled to 1500 m. in the coastal zone without finding anything of commercial significance, and the same was true in the Vojussa zone. In 1927 drilling was undertaken in the Devoli zone and an oil-impregnated sand was found. Further geological and geophysical work ensued, and in 1935 commercial production was established.

Some 290,000 m. have now been drilled in Albania, using modern methods. A 74-km. pipe-line has been built to the sea. The oil is asphalt base, giving 13% of gasoline on distillation and 80% on hydrogenation. G. D. H.

380.* Early Exploration Methods. H. B. Goodrich. *World Petrol.*, May 1939, **10** (5), 32–37.—The early drilling was not intentionally for oil, but for brine, and prior to the commencement of oil exploration, wells had been drilled to over 2000 ft. One of the earliest well logs was prepared by Hildreth for a salt well. Lesley fostered the use of well logs.

The anticlinal theory of oil accumulation was probably initiated about 1840, for Hildreth indirectly associated oil accumulation with structure. Before oil wells were drilled albertite was mined and shipped from New Brunswick for retorting, and in a law case discussions devolved on whether it was a bedded deposit, had been injected into a fissure or was on an anticline.

For a long time uses for petroleum in one form or another had been known, but the small requirements had limited development to seepages or accidental discoveries.

In 1811 Aikin put forward ideas on oil origin. G. D. H.

381.* Near East Discoveries have Led to Vast Increase in Activities. Anon. *World Petrol.*, June 1939, **10** (6), 44–51.—The Kirkuk structure which yields 30,000,000 brl./year is now a settled field. The wells are 1000–3500 ft. deep, and penetrate sandstones, silts, salt, gypsum, anhydrite and limestone. Oil is obtained from a limestone horizon. The drilling practice is described. In recent years drilling in has been carried out with crude oil circulation.

Drilling has been begun in the Qatar principality.

In Iran the Masjid-i-Sulaiman and Haft Kel fields are now stabilized with an output of 10,000,000 metric tons/year. At Haft Kel productive conditions have been proved in the Eocene below the Asmari. In the north-west in the White Oil Springs area is a separate structure with important possibilities. A new field has been developed at Gach Saran. This is under very high pressure, and the zone proved is 20 ml. long and 5 ml. broad. At Agha Jari, 55 ml. south-east of Haft Kel, producing conditions have been found, and at Pazanum, to the south-east, gas has been found in two wells, with high hopes of finding oil. On the Lali structure, north-west of Masjid-i-Sulaiman, a well has obtained a small production. In 1938 a successful well was drilled in Kuwait. The discovery well on Bahrein Island came in at 2008 ft., and an elongated anticline running north-east to south-west was proved with oil in a Cretaceous limestone and sandstone. At 4700 ft. even greater production was found, and

altogether there are four producing horizons down to 4700 ft. Fifty-six wells produce from about 2250 ft. The present production is over 20,000 brl./day.

In 1936 oil was found on the Dammam structure of Saudi Arabia, some 50 ml. from Bahrein. The yields from about 2175 ft. were small, but in 1938 prolific production was found at 4200 ft. The daily production is about 8000 brl., and a pipe-line has been constructed to Ras Tanura. At Abu Hadriya, to the north, a wildcat is being drilled.

Developments at Dhulian, in India, are satisfactory, and four wells have been drilled to the producing horizon at 7700 ft.; the last one giving 3000 brl./day. Little oil is being obtained at Khaur, but a deep test is under way at Jhatla. A further test is being made at Ganda Kas, north-west of Khaur.

Extensive geophysical work has been carried out in Western India and Assam, in addition to geological work and aerial photography. Geophysical work is in progress in the state of Bahawalpur in the Punjab. G. D. H.

382.* Ras Gharib Discovery Brings Rush of Prospecting Activity to Egypt. Anon. *World Petrol.*, June 1939, **10** (6), 52–53.—The Gemsah field was opened in 1912, but closed in 1927. In the meantime the Hurghada field, 50 ml. to the south, was discovered, and reached its peak in 1931. This field is difficult to operate, due to the production of an emulsion. Under the new mining law of 1937 geological and geophysical work was undertaken which led to the discovery of the Ras Gharib structure, midway between Suez and Hurghada. The first well gave 150 tons of oil/day from 2560 ft. Seven wells have been completed, which gave 80,000 tons in 1938. This oil is not emulsified.

Exploration has been carried out elsewhere, and tests are to be drilled 8 ml. inland from Ras Gharib, and also in Sinai. A well at Dishet el Dhaba was abandoned at 2000 ft. in granite in 1938, and a second well on Giftun–Saghir Island, 15 ml. to the north-east, was stopped at 2970 ft.

In the coastal regions of French Equatorial Africa, between Pointe Noir and Port Gentil, are surface indications of oil. Three wells have been drilled to 1315, 2300 and 2960 ft. without finding commercial oil. In Nigeria there are extensive bituminous deposits, which are being re-tested. A deep test is under way on the Waki dome near Butiaba in Uganda, and shallow borings are to be made at Kibero. Several shallow holes have been drilled in the Belgian Congo, on the other side of Lake Albert. In Ethiopia and Italian Somaliland the work has not yet revealed anything justifying drilling. G. D. H.

383.* Petroleum Search Broadened in Far East. Anon. *World Petrol.*, June 1939, **10** (6), 54–61.—Exploration is concentrated chiefly on the islands of Sumatra, Borneo, Java, and New Guinea. Production is obtained in North and South Sumatra and Djambi, East Java, the Tarakan and Samarinda regions of East Borneo, and Ceram.

Access is difficult in Central Sumatra, but geological and geophysical work has been carried out and two wells have been drilled. The first did not find production, and the second was at 1386 ft. in May.

Renewed attention is being given to Sarawak and Brunei. Oil was discovered in Brunei in 1927, and the present potential is 1950 tons/day of heavy oil and 600 tons/day of light. Some of the sands run under the sea.

In 1938 drilling was started in the Gisborne area of the North Island of New Zealand. Five different sites are under consideration in the Philippines: in parts of the province of Leyte; the Bondoc peninsula in Tayabas; the provinces of Cagaya and Isabela in North Luzon; Cebu province and Cotabato in Mindanao. G. D. H.

384.* Alaska—Farthest North. J. Collins. *World Petrol.*, June 1939, **10** (6), 62–63.—Oil has been found in small quantities in shallow wells in Alaska, and two wildcats are now being drilled. In 1938 drilling was started on Bear Creek dome near Kanatak, and in May this year was at 3000 ft.

On the Iniskin–Chinitna peninsula work began in 1936. By the end of 1937 a well was drilled to 5051 ft., and gas and oil had been encountered. At 6150 ft. several feet of oil sand were found. Drilling was difficult. The Iniskin structure is an anticline 12 ml. long on which Jurassic beds have been drilled in the hope of finding heavy production in the underlying Trias. G. D. H.

385.* Intensive Exploration Awaits New Oil Law in Rumania. Anon. *World Petrol.*, June 1939, **10** (6), 64.—The Rumanian production declined again in 1938, for the mining laws did not encourage exploratory work. 45% of the oil was from Moreni–Gura Ocnitei, with Boldesti providing 15% and Ceptura 10%.

The Tzintea–Liliesti field, some 7 km. long, is being rationally developed with unit operation on the south flank. Many of the wells are over 9000 ft. deep.

Sixteen wildcats were drilled in 1938. At Manesti an important high-pressure gas dome was found, and one well found commercial oil. The Draganeasa well obtained 50 tons/day; but none of the others found commercial oil. G. D. H.

386.* Decade of Exploration Fails to Reveal Additional Italian Reserves. Anon. *World Petrol.*, June 1939, **10** (6), 66–69.—It was not until 1891, and after many attempts, that oil in commercial quantities was proved in Emilia in the Velleia field. By 1918 there were also the South Giovanni and Vallezza fields, but the total production, which reached its peak in 1911, was small. In 1926 the Government took up the search, and a second and bigger maximum was attained in 1933. The Fontevivo fold was proved productive and the Apennine margin of Emilia was shown to be rich in natural gas. From 1933 to 1938 deeper drilling was tried in areas revealed as favourable by geological and geophysical work. However, the prospective oil horizons proved to be much deeper, especially in the Po valley, than was at first supposed.

Work was also carried out in Italian East Africa. On Great Dalaac Island a salt dome was found at 300 m., and there are reports of oil shows. Shallow drilling in East Libya has not shown oil in commercial amounts.

In Albania there are three zones: in the north, near Scutari; in the centre, between Durazzo and Tirana; and in the south, between Valona and the Semeri river. There are indications of good oil possibilities between Pechini and Elbassan, and between Berat and Lushnia, but the greatest activity is in the Devoli fields.

Deeper drilling is to be undertaken in Emilia, and ten wells are to be sunk in Sicily. The 1927–36 gravity survey of the Po valley and geo-electric surveys were followed by drilling in various parts of Italy. All the indications pointed to the oil being very deep.

The drilling methods are described. G. D. H.

387.* Europe Scene of Active Oil Search. Anon. *World Petrol.*, June 1939, **10** (6), 70–74.—The Hardstoft well in England was re-conditioned and gave 15 brl./day. In 1938 a small production was obtained near Dalkeith in Scotland, and other wells are being drilled there. There are two gas horizons. At Cousland there were five gas horizons, and a gas show was found at Eskdale. The Carboniferous limestone was barren at Gun Hill.

In 1938 Pechelbronn gave 500,000 brl. of oil, and wells are to be drilled at Sundhouse and in Haute Savoie in France. Wells have been drilled in Herault without success, but in the Gabian district fourteen wells were brought in during 1938, making a total output of 156,000 brl. in the year. At Pezenas an impregnated layer was found at 2400 ft.

Drilling was intensified in Germany in 1938, and there was a rise in production during the early part of 1939. Production rose at Nienhagen, but fell at Oberg and Wietze. There was a great increase at Reitbrook.

A production test was completed at Sank-Ulrich.

The Gbely wells are relatively shallow, and there are small fields at Bohuslavice, Turzova and Mikova. At Hodonin in Morovia much of the oil is from 460 ft., although the deeper wells go to 2950 ft. Gas production has been developed at Vacenovice, and there are good prospects at Watzinowitz, Zborowitz and Sokolnitz.

In 1938 work extended the fields in Poland and production rose slightly. A test was started near Rzepienniki, and a rich oil deposit is said to have been found at 220 ft. about 3 ml. north of Jaroslaw.

Although there has been favourable exploratory work at Buk-Kszek in Hungary, the main developments are at Lispe and Buda. A wildcat, at Magyar St. Miklos, east of Buda, has reached 8333 ft. At Buda the wells range 787–8104 ft. in depth.

Geological and geophysical work has been carried out in Portugal, and a well is to be drilled 30 ml. north of Lisbon. In Epirus, North-west Greece, there is a large

outcrop of asphaltic sand which is being explored. At Cuarny in Switzerland a well went to 6580 ft. without finding satisfactory oil or gas indications. In South Sweden promising oil strata are reported at Soderslatt, and a concession has been granted on the island of Gotland. Geophysical work is in progress in Denmark. In Greenland oil has been located on the peninsula of Nugssuak. G. D. H.

388.* Important Peruvian Area Opened by Aguas Calientes No. 1-A. J. E. Brantly. *World Petrol.*, June 1939, **10** (6), 77–81.—The Aguas Calientes structure is about 400 ml. N. 35° E. of Lima. Access is via the Ucayali and Pachitea rivers, and the concession is in the geosyncline which runs from Trinidad to Colombia, and thence south to Bolivia and the Argentine. The sediments range from Lower Palæozoic to Upper Tertiary, but in the immediate vicinity of Aguas Calientes only Mesozoic and possibly Permian is involved. The beds consist of red sandstones and shales, limestones and marls; sandstones, grits, conglomerates, volcanic ashes and a lower limestone horizon. The slightly asymmetric structure runs north-west to south-east, with dips not over 25°. It is about 15 ml. long with 3500 ft. of closure, and is the last basinward fold of the Andean Cordillera. The Chonta anticline at the south-east end of the concession is much smaller, and probably separated by a fault. The Lower Limestone (Jurassic ?) may be the source-rock. There are numerous seeps in the mountains south and west of Aguas Calientes.

The history of the concession is described. The first well, begun in 1938, found various oil horizons, including a zone from 1021 to 1261 ft. The second was drilled in February, and gives 2500 brl./day through tubing. A pipe-line will have to be built to Pucallpa on the Ucayali. G. D. H.

389.* Development Along the South American Oil Belt. Anon. *World Petrol.*, June 1939, **10** (6), 90–95.—In 1938 Trinidad gave 17,736,176 brl. of oil. The established fields were extended and tests located in the central part of the island after geophysical work. Wells were drilled which showed the Palo Seco and Coora areas to be connected. A well on the flank of the old Point Fortin field found good production. At Point Ligoure production was obtained at 7000 ft.

Venezuela's 1938 production was 173,506,497 brl., 70% being from the Lake Maracaibo fields. In Eastern Venezuela the Oficina and Santa Ana fields have recently been developed. The Infantas, La Cira, Petrolea, and Rio de Oro structures are productive in Colombia. Tests are being made in the Magdalena valley.

Commercial production in Ecuador is confined to the Santa Elena peninsula. In Argentina oil has been developed in the provinces of Chubut, Salta, Mendoza and Neuquen. Work has been resumed in British Guiana, and there has been geological and geophysical work in Guatemala.

Small amounts of oil have long been known in Cuba, and there is a natural gasoline field at Motembo and an oil and gas-field at Bacuranao. Tests have been made elsewhere. G. D. H.

390.* High Rate of Production Indicated for Illinois Fields. A. H. Bell and W. H. Voskuil. *World Petrol.*, Aug. 1939, **10** (8), 30–36.—Between 1936 and 1938 Illinois production rose from 4,500,000 to 24,000,000 brl./year. Illinois development began in 1904, and the first production peak was in 1908. Development fell off, due to its basinal character and the difficulties introduced by surface drift, but the introduction of geophysics was of great assistance, and in 1937 the Patoka pool was discovered. This was followed by the discovery of the Cisne pool. The Louden and Salem fields lie on the west side of the Illinois basin and produce from a sandstone in the Chester (Upper Mississippian).

The accumulation of oil in the new Illinois fields seems to be controlled mainly by large closed structures. Stratigraphical tables and maps are included.

The questions of refinery capacity and crude disposal are discussed. G. D. H.

391.* New Guinea Oil Search to be Intensified. Anon. *World Petrol.*, Sept. 1939, **10** (9), 23–25.—The N.N.G.P.M. has sunk eighty shallow wells after preliminary aerial and geological work. A deep test has been started in the South Vogelkop area.

In Papua three bores have been sunk on the Aiapu structure, and the underlying

mudstone has been shown to be petroliferous. There were evidences of shore-line conditions, but the wells were not deep enough to prove or disprove the existence of suitable reservoir rocks. G. D. H.

392.* What of Canadian Oil? H. G. Cochrane. *World Petrol.*, Sept. 1939, **10** (9), 31–36.—The discovery of heavy oil at Turner Valley in 1936 sent up Canadian production rapidly, and in 1938 Alberta gave 97·54% of Canada's oil output. The Turner Valley field seems to extend for 18 ml., and there are possibilities of an even greater extension. A potential of 55,000 brl./acre is estimated for it.

Oil has been found in the Blackfoot-Ribstone well 30 ml. south-east of Wainwright, whilst one 30 ml. east of Lethbridge is attracting attention. Tests are being made near Lundbreck, Clearwater River, Brazeau, Highwood, Moose dome, Milk River and Del Bonita. A test has been started on the Grease Creek structure 45 ml. north-west of Calgary.

In 1938 proration was introduced in Alberta, and this was followed by gas conservation.

In Alberta 85·5% of the crude is from the Turner Valley limestone, there is 10% of naphtha from the Turner Valley limestone, and 1·5% of crude from shallow horizons and other fields.

Markets, transport, pipe-lines, drilling, and royalties are all discussed. G. D. H.

393.* Maracaibo Geology. Anon. *World Petrol.*, Dec. 1939, **10** (13), 84–85.—The Maracaibo basin was separated from a larger Venezuelan geosyncline in Tertiary times. The northern third has a thin covering of younger beds over folded older Tertiary, with most of the Middle and Upper Tertiary absent. The southern two-thirds may have been subsiding from Miocene to Recent times, for there are thick shallow-water deposits, and in the Middle Tertiary there were open-sea conditions for a time.

Generally the oil pools are on domes or anticlines in Cretaceous to Middle Miocene beds, on monoclines with reservoirs wedging out up-dip, or in combinations of these two sets of conditions. Shore-line accumulations now give most oil.

There is often a marked angular unconformity between the Miocene and Pliocene. G. D. H.

394.* Oil Geology of Quiriquire. Anon. *World Petrol.*, Dec. 1939, **10** (13), 112.—Quiriquire lies in the Maturin basin. Wells penetrate Pliocene, Miocene, and mid-Oligocene formations separated by unconformities. Cretaceous beds outcrop 3 km. north of the field.

The Quiriquire formation (Pliocene) contains an upper heavy oil zone, a zone of light oil, and a lower heavy oil zone. The oil is in lenses about 25 ft. thick and averaging 20 acres in extent. The oil is apparently migrant from an unknown source, but by analogy with Trinidad, the Upper Cretaceous has been suggested as an important possible source. G. D. H.

395.* Recent Discoveries Keep Illinois Busy. H. F. Simons. *Oil Gas. J.*, 28.12.39, **38** (33), 59–60.—The development of Devonian lime production in fields producing from the Ste. Genevieve or Chester formations is now holding attention in Illinois, and four fields producing from the upper horizons have found Devonian oil; two have had Devonian showings, and at Louden the discovery well was a small Devonian producer. In the Salem field the Devonian pay seems to be thicker than at Sandoval to the north, where it is 6 ft.

Electrical logs of Devonian wells have shown in most cases that the lower part of the pay horizon contains water, and heavy water production has been noted in the Sandoval field. Estimates of total recovery from the Devonian range from 3500 to 10,000 brl./acre, and there are several old Devonian fields in Illinois on which to base such an estimate.

The Prairie Creek field, one of the newer fields in the region, has a productive area of about 600 acres. G. D. H.

396.* All Operations Gain in Venezuela. L. H. Figueredo. *Oil Gas J.*, 28.12.39, **38** (33), 171–172.—Venezuela's 1939 production will be about 208,000,000 brl., an increase

of nearly 20,000,000 brl. over 1938. In addition to wildcats near more or less proven territory, there were tests in North and South Guarico testing Central Venezuela; the Alquitrana well in South-west San Cristobal in the folded zones of the Andes and No. 1 Cubagua, on the small island of Cubagua, 55 km. due north of Cumana.

In 1939 Oficina and Jusepin joined the list of producing fields. In the former, which may become the largest field in Eastern Venezuela, the thirty-one wells average about 2000 brl./day each. 25 km. north-west of Santa Ana is a possible new field, whilst north-east of Santa Ana in San Joaquin, four wells have found oil. In the El Roble area the first wildcat gave 800 brl. of paraffin base oil daily.

There are nine wells at Jusepin, and a 10-in. pipe-line connects this field with Caripito, a distance of 43 ml. The 96-ml. 16-in. line from Oficina to Guanta is now in use. This will also be available for El Roble, Santa Ana, and San Joaquin.

A new refinery was opened at Caripito, and at La Salina and San Lorenzo the capacity has been increased. G. D. H.

397.* Brazil's Search for Oil. E. de Carvalho. *Oil Gas J.*, 28.12.39, **38** (33), 68.—The Algoas basin is one of the many basins in the coastal belt, and contains Cretaceous, Eocene, and Pliocene beds resting on pre-Cambrian. The Eocene has good oil and gas shows at relatively small depths. The structures are complicated and much broken by faulting. By geophysical methods at least one anticlinal fold with several domes has been located. G. D. H.

398.* Persian Gulf Area Extends Oil Activities. H. S. Norman. *Oil Gas J.*, 28.12.39, **38** (33), 70.—Five producing wells were completed in 1939 on the Dammam structure of Saudi Arabia, with the result that the 1939 production was 4,300,000 brl. A well is under way at Abu Hadriya, 100 ml. north of Dammam, but, like the well at Ma'agala, it has not shown oil. Eight wells are producing from the lower pay at Dammam. Further concessions have been granted in Saudi Arabia.

In Kuwait three wells have been completed on the Burgan structure, which is said to be 30 ml. long.

In Iran a 165-ml. 12-in. pipe-line has been constructed from Gach Saran to Abadan, but the field is not yet in commercial production. The productive Naft-i-Safid structure has been shown to be comparatively small, complex and somewhat inferior to the other Iranian fields. On the Agha Jari-Pazanum structure north of Gach Saran, oil has been discovered at 8810 ft.

The Iraq production fell in 1939 by about 12%. The Bahrein production also fell. Bahrein has now sixty-two wells giving oil from zones at 2000, 2250, 4000 and 4600 ft. G. D. H.

399.* Marked Expansion in Argentina. E. P. Canera. *Oil Gas J.*, 28.12.39, **38** (33), 72.—In 1939 three wells were completed in the Tupungato region, all being good producers. A rise in production took place at Comodoro Rivadavia and at Plaza Huincul, but there was a decline in the Salta province. The total production for 1939 is estimated at 2,930,000 cu. m., where 1 cu. m. is 6·29 U.S. barrels. G. D. H.

400.* Alaskan Wildcat Nearing Critical Point in Depth. L. P. Stockman. *Oil Gas J.*, 28.12.39, **38** (33), 83.—A wildcat on the eastern side of the Alaskan peninsula across the Shelikof Strait from Kodiak Island has reached 6390 ft. It has shown gas at times, but no satisfactory oil sand has been logged. The operations are in the Kanatak district, where a well-defined anticline was found in the Salmon Creek valley.

The operating problems are described.

In 1922 two wells were drilled on the Pearl Creek structure 25 ml. north-west of Salmon Creek. The first well was stopped at 5003 ft. in 1926 without reaching the Trias. The present well is to test the Jurassic–Triassic contact, and has shown several tight sand bodies.

The occurrence of oil in sediments on the Alaskan peninsula has been known for over 60 years, for there are numerous seeps in the Cold Bay area, around Aniakchak Bay and Chignik. At Cold Bay they are on two lines of folding. These seeps are in sandstones of the Shelikof (Up. Jur.) formation. There are also gas seeps on the

eastern fork of the Kejulik river. At Cold Bay the strike is north-east to south-west, and the north-westerly dip is interrupted by at least two lines of folds and faults which parallel the coast. The Bear Creek–Salmon Creek anticline has dips of 4° to the south-east and 16° to the north-west. In the core sandy lower Shelikof shales are exposed with Naknek beds on the north-west flank. It is faulted in the north-east.

The Pearl Creek dome is asymmetrical with the south-east flank dipping up to 30° and the north-west flank up to 69°. Naknek beds are at the surface on this very promising structure.

The Mesozoic and Tertiary beds of Alaska have many unconformities, but the Jurassic appears to be over 6200 ft. thick. The Lower Jurassic and Upper Triassic appear conformable, and the former contains limestones and calcareous sandstones and shales, and an upper zone of conglomerate and sandstone. G. D. H.

401.* Present Status of Mexican Oil. Anon. *Oil Gas J.*, 28.12.39, **38** (33), 94.—The first nine months of 1939 yielded 30,313,561 brl., as compared with 26,291,848 brl. in 1938. In the Tampico area two 1600-brl. wells were completed, and five were completed at Poza Rica with a capacity of 35,000 brl./day. In the El Plan field of the Isthmus of Tehuantepec six wells were successful, their total output being 6400 brl./day.

Geological and geophysical work has been undertaken, and various pipe-lines are projected or under construction. The waste gas of the Poza Rica field is to be utilized. G. D. H.

402.* Fyzabad Structure Continues Trinidad's Largest Producer. Anon. *Oil Gas J.*, 28.12.39, **38** (33), 117.—Fyzabad gave 40–45% of Trinidad's production in 1939. Activity was concentrated between the Forest Reserve, Los Bajos, and Palo Seco areas where a continuous productive zone seems to have been established. Two deep wildcats are being drilled north of the Central Range. G. D. H.

403.* No New German Fields; Production Mounting. C. H. Ehlers. *Oil Gas J.*, 28.12.39, **38** (33), 117.—Although no new field appears to have been discovered in Germany in 1939, the output of the old Reich oil-fields will be 4,803,000 brl., as against 4,125,000 brl. in 1938. The Austrian production is also thought to have risen.

The Reitbrook field is said to have 25 wells with an initial production of about 1000 brl./day/well, and the Zistersdorf–St. Ulrich field has probably been extended. The Nienhagen field is the chief producer, yielding 2,700,000 brl./year.

The possibility of drilling south of Wietze is reported and a big gas-well has blown in near Bentheim. G. D. H.

404.* Bolivia Outlines Program for Coming Year. Anon. *Oil Gas J.*, 28.12.39, **38** (33), 120.—Two of the tests started in the Sanandita field have been completed as producers at about 2000 ft. with a combined initial production of 1258 brl./day. This field lies in the sub-Andean zone which has fifteen fields or prospective producing areas: Bermejo, San Telmo, Sanandita, Caigua, Camatindi, Machareti, Buena Vista, Camiri, Saipuru, Guariri, Tatarenda, Espejos, Isiboro, Chapare and Caupolican. Tests have been made at Bermejo, Camatindi, Machareti, Buena Vista, and Saipuru. Drilling is scheduled in the Rio Ichilo and Caupolican areas.

Sanandita is an asymmetric dome 2 ml. long and ½ ml. wide, with a red sandstone, conglomerate, and shale core, and marked by seeps. The Devonian shales are the most important producers. Oil zones have been found at 1440, 1624, and 2017 ft.

The Camiri structure showed productive oil zones at 3133 and 3274 ft. In one test very high gas pressures were encountered at 1365–1555 ft. A small output has been obtained at Buena Vista, Camatindi and Saipuru.

Pipe-lines and refineries are to be expanded. G. D. H.

405.* Intensive Exploration Due in West Indies. Anon. *Oil Gas J.*, 28.12.39, **38** (33), 122.—Two producing wells have been completed on the Maleno structure in Dominica at about 475 ft., and one gives 90 brl./day. The first well blew out at 1100 ft. and was completed in the shallow zone. The second was taken to 1200 ft. and encountered

cavernous limestone. It was plugged back to the shallow zone. 12 ml. to the west at Quita Coraza a wildcat has reached the " big lime " at 3290 ft. There are other structures which will be tested. G. D. H.

406.* Rumania Production Slightly Under 1938. Anon. *Oil Gas J.*, 28.12.39, **38** (33), 122.—Political considerations have not encouraged work in Rumania, although in 1939 drilling was maintained at the 1938 rate in the proven fields. Two or three fairly large wells were completed in the old Baicoi field, but they did not offset the normal decline. Tzintea has a daily production of nearly 25,000 brl., and wells in the south Meotic unit yield oil from about 8800 ft. The Gura–Ocnitei field gives 25,640 brl. daily from 323 wells 5400–5900 ft. deep. At the end of the year Rumania was reported to have 128,196 brl. of oil/day from 2261 wells. G. D. H.

407.* Spectacular Rise Reported in Egypt this Year. Anon. *Oil Gas J.*, 28.12.39, **38** (33), 124.—The Egyptian output of 5,100,000 brl. was 207% above the 1938 yield. This increase was exclusively from the Ras Gharib field. Oil is obtained at depths of 2500–3500 ft. in this field.

A wildcat was drilled at Dishet el Dhaba, a few miles south of Hurghada, and entered granite at 2000 ft. On the Giftun–Saghir island, 15 ml. to the north-east, a test was abandoned at 2970 ft. owing to mechanical difficulties. A third test was drilled north-west of Hurghada.

Shallow tests are being made on the south side of Lake Albert in the Belgian Congo, and a deep test is being made on the Waki dome near Butiaba. G. D. H.

408.* Limited Exploitation in Ecuador during Year. Anon. *Oil Gas J.*, 28.12.39, **38** (33), 124.—Exploitation and production in 1939 were confined to the Santa Elena peninsula. In the new Tigre field, north-east of Ancon, four wells were completed at about 3800 ft., giving 150 brl./day each. At Cautivo drilling was continued to the Socorro sand, which there yields oil to eighty-five wells. The Socorro sand is also productive at El Tambo.

In the Carolina area some thirty-five wells obtain oil at depths down to 1000 ft. Its output is about 200 brl./day. The eastern and north-eastern boundaries of the Ancon field are as yet undefined.

Two wildcats have been drilled on the San Gabriel grant east of Ancon.

G. D. H.

409.* Japan is Ill Prepared to Weather Potential U.S. Embargo. H. Leopold. *Oil Gas J.*, 28.12.39, **38** (33), 160.—During 1939 Japan's production fell. Drilling was undertaken in the Akita, Tsuchisaki, and Nagaura districts, and there was great activity in the Kotaki field, where several relatively shallow wells were completed. Oil was struck at several places in the Omono River district at less than 300 ft., and altogether 1896 wells were in operation in the Akita prefecture in 1939.

Several deep wells have been begun in the Kinsui field in Formosa, and deep wells are projected in the old fields of Niigata.

The political aspects of the oil situation, the production of synthetic fuels, etc., are all discussed. G. D. H.

410.* South Louisiana Reserves are Increasing Steadily. C. Leyendecker. *Oil Wkly*, 1.1.40, **96** (4), 21–24.—During eleven months in 1939 the completions were 734, as compared with 520 in the corresponding period of 1938, and although allowables were reduced in several fields, production was up by 2%. In 1939 fourteen new fields were discovered in South Louisiana, about one field being found for every five wildcats. This high success ratio is due to geophysics.

Nearly half a million barrels of oil have been produced in South Louisiana.

Four of the new fields are 10,000–11,000 ft. deep and seven between 8000 and 9000 ft. Fifty-two new sands have been found in the old fields. Thirty-two wells have been drilled to more than 11,000 ft. Paradis and Eola are believed to be the most important discoveries. The latter produces from the Wilcox. The other new fields are: North Elton, Perkins, Grand Lake, Vermilion Bay, Lafourche Crossing, Potash, Kennilworth, LaPice, LaPlace, Happytown and Henderson.

At Ville Platte, which gave Sparta production, Wilcox oil has now been found. Seven new oil-sands were discovered at Golden Meadows.

A map shows the positions of the fields. G. D. H.

411.* Mississippi Looms as Nation's Major 1940 Geophysical Play. J. H. Todd. *Oil Wkly*, 15.1.40, **96** (6), 15–20; 22.1.40, **96** (7), 20–26.—When the Jackson field was declining rapidly, the Tinsley structure was drilled in search of gas, and oil was found. This led to a rapid increase in geophysical work in Mississippi. Mississippi is on the eastern side of the geosyncline of the Mississippi embayment, and there are associated smaller basins. Their prospects are deemed good, for prospecting has shown that oil does occur in structural basins.

The magnetometer shows highs on the basement, and 600 gamma closure highs are avoided because of the proximity of igneous rocks to the surface. Magnetic closures of 15–25 gamma are preferred for drilling here. Faults can also be traced by the magnetometer.

Many gravity meters are being used in Mississippi, and whilst they eliminate useless areas, every gravity anomaly is by no means a structure. Some crews can cover 1000 gravity-meter stations/month, at costs of 1–2 cents/acre in Mississippi. Seismic work is restricted to favourable areas for detail work in advance of the drill.

G. D. H.

412.* Paluxy, Pettit Discoveries Intensify Deep Search in East Texas. J. A. Kornfeld. *Oil Wkly*, 22.1.40, **96** (7), 12–14.—Recently high-pressure gas has been found in the Paluxy sand member and the Pettit oolitic lime zone of the Trinity. At Chapel Hill the Paluxy is 5533 ft. deep and on a short test gauged 15,000,000 c. ft./day of gas at 350 lb./in.^{2}. This sand has potentialities on fault structures, deep-seated domes and stratigraphic traps. The fault structures include Sulphur Bluff, Talco, and the Garland City fields. Chapel Hill may be a deep dome, whilst lenticularity is said to be effective at Garland City.

In November gas production was developed in the Groesbeck segment of the Mexia fault zone in the Pettit oolitic zone of the Lower Glen Rose. This was at 5591 ft., and 5,575,000 c. ft./day were gauged with 5 brl. of water-white distillate/1,000,000 c. ft. of gas.

The Pettit zone gives oil and gas at Sligo, Lisbon, Longview, and Waskom.

G. D. H.

413. Reservoir Characteristics of the Eunice Oil-Field, Lea County, New Mexico. C. C. Anderson, H. H. Hinson, and H. J. Schroeder. U.S. Bureau of Mines, Report of Investigations, No. 3456, July 1939.—The Eunice oil-field is situated in South-east New Mexico and produces from dolomitic limestone. Oil-wells in this type of rock are prone to exhibit striking differences in their individual productive capacities even within small distances from one another, and these conditions prevail in this case. Erratic variations in porosity, permeability, and in the vertical distribution of productive zones have provided difficult problems, and no direct relation was known between the areal structure and the manner of oil accumulation within the reservoir. A detailed study was consequently made of the position and characteristics of the oil- and gas-producing zones, which included analysis of " top-oil-pay " data, comparison of initial well potentials, study of water encroachment, and interpretation of porosity and permeability data obtained from examination of core-samples. Co-ordination of the facts thus obtained resulted in the establishment of three major porous and permeable zones in this field which are independent of lithological units and may not be directly related to geological structure. The methods applied satisfactorily here are thought to be applicable to other limestone-type reservoirs where similarly difficult subsurface conditions may exist. H. B. M.

414. Oil In Uganda. Anon. *Bull. Imp. Inst.*, 1939, **37** (4), 639.—In a report received by the Imperial Institute from the Director of the Geological Survey of Uganda it is stated that a site for a deep oil well has been selected near Kibero, Lake Albert, in the vicinity of hot salt springs, and drilling will soon be started. H. B. M.

415.* Geology of Bahrein Island. O. Kühn. *Oel u. Kohle*, 5.10.39, **35** (37), 702–704.—In spite of the reticence of the oil companies, it is possible to get a fair picture of the geology of Bahrein from the data published by Pilgrim and Heim and from a knowledge of the surrounding areas. Heim's identification of Cretaceous rocks was incorrect, a close study of Pilgrim's data showing the oldest exposures to be Eocene. This error was probably due to a badly drawn section of the Jebel Dukhan. If the dips had been correctly drawn it would have showed the rocks in the centre of the area to be the youngest, instead of the oldest, as had been assumed.

Bahrein lies at the edge of the Arabian Foreland, towards the Iranian Orogen. The horizontal bedding of the Miocene above the gently domed older rocks is suggestive of Stille's Savic phase of movement. In other parts of the Persian Gulf the same phase, domes with discordant Fars on Palæogene, is seen. These domes, however, have partly an Iranian orientation, with their shorter axis at right angles to that direction. At Bahrein, on the other hand, it is the short axis which has the Iranian orientation, whilst the longer is orientated north to south. It appears probable, therefore, that Savic folding in the Iranian direction was superimposed on an original north to south folding. S. E. C.

416.* Gravity Map of Poland, with Observations on the Southerly Continuation of the Tempelburg Axis. H. Closs and R. v. Zwerger. *Oel u. Kohle*, 1.1.40, **36** (1), 2–6.—A north-west to south-east gravity high to the south-west of Thorn and Bromberg represents the continuation of the Tempelburg axis. The low-gravity values to the south of Bromberg and the Lodsch gravity low indicate, however, that in this area the uplift has been displaced. There is thus no straight connection between the Tempelburg axis and the Polish Mittelgebirge (Kielce to Sandomir). The axis, after the break in the Hohensalza district, continues south-east, and there is probably a connection between it and the Upper Silesian–Polish massif. The salt-stocks of the Bromberg basin reach the zone of regionally low-gravity values, and lie partly on the edge and partly on the break of the Tempelburg axis. The occurrence of natural gas at the edges of the Hohensalza salt-stock makes the Bromberg structures interesting to the oil geologist and raises the question whether the oil indications in the neighbourhood of the south-east continuation of the Tempelburg axis are associated with salt masses or with faults. S. E. C.

417.* Occurrence of Bituminous Shales in the Lika, Yugoslavia. G. Petunnikov. *Oel u. Kohle*, 1.1.40, **36** (1), 6–9.—Bituminous shales are found in the southern corner of the Lika, a district in the west part of Yugoslavia. These shales have been placed between the White Dolomite of the Upper Jurassic and the *Cladocoropsis* limestone, but as they are also found in a position where the Lias–Trias contact is said to occur, further investigation seems to be necessary. Shallow shafts have shown that they extend over a considerable area. The thickness of the shale series appears to be of the order of 120–200 ft., and it consists of a large number of thin marl beds which are more or less impregnated with oil. Part of this series weathers to a light colour, whilst the rest remains brown. The shales yield 5–6% of oil on solvent extraction with CS_2 and 20–25% on destructive distillation. The oil obtained is of good quality, and is much better than that yielded by the Esthonian shales. S. E. C.

418.* Southern Part of the Benthe-Gehrden Salt-stock. L. Riedel. *Oel u. Kohle*, 15.1.40, **36** (3), 27–33.—This paper is concerned with the uplift of the Hannoverian salt-stocks, and the southern part of the Benthe-Gehrden salt-stock is considered in detail in order to throw light on the subject. The stratigraphy and structure of the area are described, and it is concluded that the uplift of the salt took place in a zone previously defined by faulting. In consequence of earlier consolidation, the effect of the salt uplift on the surrounding rocks was small and was limited to the dragging up of a fault block of Cretaceous rocks and the tearing off and squeezing into a crush zone of softer rocks from below. Further evidence that the uplift took place in a zone previously defined by faulting is its position in the lattice-work formed by Rhenish and Hercynian disturbances. This salt-stock is therefore an example of the fact that in many cases the structure of an area has not been determined by the salt, but by earlier fault tectonics. S. E. C.

Geophysics.

419.* Geophysical Work in Prospective Polish Oil Regions. R. v. Zwerger. *Oel u. Kohle*, 5.10.39, **35** (37), 697–701.—There are two principal areas in Poland where geophysical prospecting for oil has been carried out: the Carpathian foreland with, to a limited extent, the north margin of the Flysch zone of the true Carpathians, and the region on the Lower Weichsel (Prov. Posen). A third area around Vilna was to have been surveyed, but it is doubtful whether any measurements have been made. The gravimetric, seismic, and magnetic work done in these areas is summarized. This work was marked by a certain lack of co-ordination between the various surveys, and in order to obtain a solid basis for future exploration and production programmes the extensive gravimetric and reflection surveys must be in part expanded and in part condensed and supplemented. S. E. C.

420.* State Oil and Geophysical Survey in Greater Germany. A. Bentz and H. Closs. *Oel u. Kohle*, 1.11.39, **35** (41), 731–740.—A summary of the work done by the survey up to September, 1939, and a discussion of the principles on which the survey is based. Its value may be judged by the fact that the eight oilfields of 1932 have now grown to twenty-five, which are divided amongst five petroleum provinces, North German, Thuringian, Upper Rhine Graben, sub-Alpine Basin, and the Vienna Basin. The type of work carried out by the survey is illustrated by the example of the Tempelburg axis and the structural investigations in the region of the Aller. S. E. C.

421.* Travel-Time Maps and Geology in E. Pommerania and in the Alpine Foreland. H. Reich. *Oel u. Kohle*, 1.11.39, **35** (41), 740–743.—Where geological conditions are favourable, travel-time maps reflect the geological structure, a seismic high, for instance, corresponding to a geological high. It is pointed out, however, that the velocity of elastic waves is not dependent on the age of the rock, but on its physical properties, and although in general the velocity in any given rock type tends to increase with age, in a series of formations the velocity may well vary widely instead of showing a steady increase. Two examples, one from East Pommerania and the other from the Alpine foreland in the neighbourhood of Kremsmünster, are dealt with in some detail in order to illustrate the care which is needed in the interpretation of these travel-time maps. It is shown that in order to get the most out of the method, travel-times should be measured for different distances. In this manner trouble due to the effect of surface beds can be eliminated and various geological structures can be isolated one from another and investigated. S. E. C.

422.* Gravimetrical Investigation of the Schleswig-Holstein Salt Uplifts. R. v. Zwerger. *Oel u. Kohle*, 1.11.39, **35** (41), 744–749.—The regional gravimeter survey of Schleswig-Holstein began in May 1935, and the two first torsion balance parties commenced work at Heide in June 1935. Seismic refraction surveys began in 1936. The results of these surveys are given on a map which shows the zones of uplift as defined by the gravimetrical work and confirmed by the seismic. Regional measurements show that the form of the uplifts, which are a Saxon–Rhenish type with a mainly Rhenish strike, is governed by the Friedrichsstädt massif in the west and the Kiel massif in the east. The Husum massif closes the area to the north. The intensity of the salt tectonics, a maximum in the younger Kimmeridgian Phase, increases with approach to the Friedrichsstädt massif. The form of the gravity anomalies differs somewhat from those typical of the Hannoverian salt-stocks. This is due to a different density distribution. In Schleswig-Holstein the core of the structure is composed of Rotliegendes salt-clay, of higher density than rock-salt. This is followed by Middle Zechstein conglomerates with Upper Zechstein rock-salt on the flanks. S. E. C.

423.* Torsion Balance Measurements over the Gifhorn Salt-stock. W. Wolff. *Oel u. Kohle*, 1.11.39, **35** (41), 750–756.—The gradient map shows a well-defined, closed gravity minimum which strikes north-east to south-west and has its centre to the north-west of Gifhorn. The gradient values are not symmetrically disposed, those in the east and south-east being of the order of 80–100 E., whereas those in the north, north-west, and

west are almost all less than 50 E. This is not so much due to asymmetry of the salt mass as to the strong regional increase in gravity to the south-east. General tectonic conditions in the Gifhorn area are discussed. S. E. C.

424.* Gravitational Effects of Salt-stocks. J. Schander. *Oel u. Kohle*, 1.11.39, **35** (41), 756–759.—The normal effect of the North German salt-stocks is to give gravity minima of the order of 3–10 m.gals. Long, narrow salt-structures, such as are to be found to the north-east of Gifhorn, give much smaller anomalies—2 m.gals. or less. In between these two types all variations are to be found, but all are characterized by gravity minima. An important factor controlling the magnitude of the anomaly is the nature of the surrounding and overlying rocks. When these are compact and dense, the anomaly will be greater than in the case of loose, unconsolidated sediments. Although gravity minima are indicative of salt in Germany, in the Gulf Coast States of America the reverse is the case. This is because of the presence there of very dense caprock above the salt. It is now being recognized, however, that small gravity minima in the Gulf Coast may be due to deep-seated salt masses. A different type of anomaly is given by the Lüneberg type of salt-stock, its characteristic being a strong, well-developed ring of maximum values around a central core where the values are of the same order as the regional gradient. This more complicated pattern is due to steeply tilted older rocks surrounding the salt and its caprock and being surrounded in their turn by younger rocks. The main gravitational effect is given by the dense older rocks. S. E. C.

425.* Geophysical Laboratory of the Reichsstelle für Bodenforschung. H. J. Schoene. *Oel u. Kohle*, 1.11.39, **35** (41), 759–761.—A short description of the apparatus and the type of work done in the geophysical laboratory. S. E. C.

426.* Relationship between Elastic Properties and Temperature in Zechstein Rock-salt. St. v. Thyssen-Bornemisza. *Oel u. Kohle*, 1.12.39, **35** (45), 767.—By means of his new apparatus for determining the velocity of elastic waves in cores (see Abs. 1084, 1939) the author has determined the longitudinal velocity of waves in a core of rock-salt taken from the Meissendorf salt-stock at a depth of 400 m. The temperature of the core was varied from 20° to 320° C. The curve relating velocity with temperature shows a sharp fall between 20° and 60° C., then a gradual decline until 120° C. is reached. After this there is a rise in velocity, which falls off at about 220° C., and finally becomes a fall again at 300–310° C. Measurements made with increasing and decreasing temperatures show good agreement. S. E. C.

427.* Geophysical Methods. Anon. *World Petrol.*, December 1939, **10** (13), 74–75.—Three-quarters of the possible producing area of Venezuela is covered by young deposits which either mask or reflect only weakly the underlying structure. Most of the geophysical work has been carried out in Eastern Venezuela.

In general the torsion balance and magnetometer have given satisfactory results. Little electrical work has been done, but continuous profiling has been widely applied. During 1939 eight gravity meter, six torsion balance, twelve seismic, two magnetometer, and four soil-analysis parties were at work in Venezuela. G. D. H.

428.* The Engineer's Part in the Search for Petroleum in the Argentine Republic. E. P. Canepa. *Bol. Inform. Petroleras*, November 1939, XVI (183), 3–26.—This paper contains an interesting study of the development of exploration work in the search for petroleum in the Argentine. It is well illustrated with geological maps, but the author directs attention, as have others before him, to the great lack of reliable geological surveys of the Argentine. In Fig. 1 it will be seen that 67·5% of the total area of the Republic has not yet been surveyed. Description is given of the stages undertaken to ascertain the probable presence of oil in the strata, before actual trial borings are made. The author then discusses the two most important methods of prospecting when for various reasons the strata are abnormal or faulty—namely, the gravimetric and the seismographic methods. In connection with the gravity measurements, the use of the Ascania torsion balance is described, and in respect to the second method named, the use of a recording seismograph is illustrated. H. I. L.

Drilling.

429.* Present Year may Approach 1937 in Drilling Activity. H. F. Simons. *Oil Gas J.*, 4.1.40, **38** (34), 15–16.—Detailed statistics are given for drilling tests completed in 1938 and 1939 as well as generalized data for the years 1919–39 inclusive. The latter chart shows repeated cycles in drilling activity with peaks occurring about every four years.

Analyses are made of past experience, and the future activity for 1940 is generally outlined, based on predictions made by the author. A. H. N.

430.* Difficulties in Offshore Drilling. N. Williams. *Oil Gas J.*, 11.1.40, **38** (35), 14–15.—A description is given of a test being started approximately 300 ft. offshore, where one of the most complete assemblies of drilling equipment on the Gulf Coast is being provided. All equipment and facilities, including mud-pits, tanks for water, fuel, and reserve mud, and various auxiliary units, are being set up at the location. A major handicap in carrying out the drilling is the marshy shore, unusually treacherous, consisting of boggy and shifting soil. No marine transport can be utilized, as the Gulf is too shallow for long distances off the shore—maximum depth at ½ mile being only 4½ ft.

The methods used in overcoming unusual difficulties in this unusual drilling site are described.

The history and prospects of this potential pool are given at the end of the paper. A. H. N.

431.* Safety—Proper Handling of Cathead. Anon. *Oil Gas J.*, 18.1.40, **38** (36), 39.—This is a short discussion on the safety precautions to be observed in handling the cathead line. The cathead man is advised to watch other men on the rig rather than the cathead itself. A. H. N.

432.* Metals in Drilling—Rotary Drilling Bits. W. L. Nelson. *Oil Gas J.*, 18.1.40, **38** (36), 45.—Recommendations are given for metal used in rotary drilling-bits, these recommendations being collected from prominent metal manufacturers, steel companies, and oil-company field men. The table gives the approximate composition in terms of per cent. C, Mn, Cr, Ni, Mo, Va, and Si, the approximate physical properties in terms of yield point, elongation, and Brinell hardness, and recommended heat treatment for metals used in bodies, cutters, pins, bits, reamers, fishing-tools, core-bits, etc.

These properties are also briefly discussed, and the paper ends with a list of references to literature on metals. A. H. N.

433.* New Casing Practice Cuts Equipment Cost. P. Reed. *Oil Gas J.*, 18.1.40, **38** (36), 53.—In casing certain wells in Texas fields several operators have been following a practice which achieves substantial savings in the investment in pipe. In one case the saving has been as much as $700 per well. Essentially this practice consists of setting light-weight pipe at greater depths than have been generally customary for pipe of this type.

Specific examples are quoted, with details of dimensions and depths. Joints were welded electrically, in one case, in 8½ hr., at a total cost of $34 or 1·1 cents/ft. lineally. Other details are given. A. H. N.

434.* Complex Phosphates for Deflocculation of Drilling Mud. C. F. Bonnet. *Oil Gas J.*, 1.2.40, **38** (38), 39.—Examination of the known chemical data on commercial sodium phosphate shows that only those classed as "complex" phosphates formed by dehydrating normal phosphates are effective for deflocculating drilling muds.

From the data given in the paper it is apparent, that while these complex phosphates are good, as a class, for lowering the viscosity of drilling muds by deflocculation, there are definite chemical differences between members of this class corresponding to the different effects they have on drilling muds. It is concluded that tetrasodium pyrophosphate, (1) has a very sharp deflocculating effect on fresh mud; (2) is quite stable in solution, but has low solubility; (3) has a higher pH value than other "complex"

phosphates; and (4) its accumulations in drilling mud will tend to increase viscosity, and this effect will retard sand settling before the increasing viscosity is apparent.

Similarly, it is concluded that sodium tetraphosphate (1) has a deflocculating effect equally as sharp, but has been observed to aid sand settling to a greater degree than the pyrophosphate; (2) is quite stable in solution; (3) has a pH value about the neutral point; and (4) its accumulation in high concentrations has little tendency to increase viscosity, or, in other words, over-treatment is not apt to occur.

A. H. N.

435.* Drilling Technique (in Venezuela). Anon. *World Petrol.*, December 1939, **10** (13), 86.—The entire issue for December is devoted to Venezuela, and in this paper the technique followed in Lake Maracaibo fields, where 1669 out of a total of 2986 wells have been drilled in the lake, is described and illustrated. A review is made of the evolution of water operations from the original crude shore-line adaptations of conventional land structures to modern special marine foundations, in 60 ft. of water and located as far as 8 miles from the shore.

Since the cost of all Lake foundations varies directly with the depth of water, the cost of erecting required pipe-racks, slush-tanks, and boiler-stations would become prohibitive in the more lakeward operations. To meet this condition, drilling-barges were developed to take the place of additional foundations. The barges, 48 ft. × 110 ft. × 8 ft. in size, are equipped with necessary boilers and pumps, ditches, pipe-racks, etc. Engine, draw-works, rotary, and blocks are erected on the well foundations. The barges are held in positions by four anchors and are not tied to the foundations. Under normal conditions wells are completed at an average depth of 3000 ft. in 10–15 days.

Producing operations are basically similar to corresponding operations on land. In many of the fields pumping and gas-lifting operations are required.

Details are given of the derricks, rigs, and power required, of the various formations drilled and specific problems encountered, of casing and of completion programmes.

A. H. N.

436.* Drilling in Eastern Venezuela. Anon. *World Petrol.*, December 1939, **10** (13), 94.—Drilling methods and equipment in use in Eastern Venezuela are described, and are found to be similar, basically, to those used in the Mid-Continent and Gulf Coast fields. Steam is the most popular form of power.

Complete unitization of rigs is adopted wherever possible. Drilling engines are unitized with the sub-structures; draw-works are made into compact units; mud-pumps are permanently mounted on wheeled wagons; feed-water pumps and generators, with all their piping, are made into skid units; engine-sheds have been designed for transportability and ease of assembling; piping connections are so made as to be transportable in sections. Where the terrain permits, derricks are skidded between locations or moved on specially designed wheeled units, whilst boilers are permanently mounted on skids.

Drilling mud control is becoming an ever-increasing problem, on account of the declining reservoir pressure in some fields. Pressure drilling is being considered as a possible solution of the problem.

Pressure-maintenance projects have been adopted wherever possible; remarkable success having been already met in some fields, as decline in pressure has been very small since these projects were put into operation.

A. H. N.

437.* Drilling Equipment Selection. J. E. Brantly. *World Petrol.*, December 1939, **10** (13), 96.—Exploration for and exploitation of petroleum deposits of Venezuela require the employment of drilling equipment of varying character and capacity. Between two extremes of aridity and relatively simple transportation problems in so far as equipment is concerned and the regions of heavy rainfall where machinery and tools can only be moved at considerable expense and roads are costly, there are the various intermediate types of terrain and natural conditions.

The choice of equipment will be governed by these conditions and by the size and depth of the hole to be drilled.

In arid regions the logical source of power is the I.C. engine, and, unless fuel considerations make gasoline or butane engines preferable, the diesel type is more popular in

view of the substantially lower cost of the fuel as compared with gasoline, and also because of the fact that the power characteristics of the diesel engines are more satisfactory on drilling operations than are those of the gasoline or butane engines. Relative cost of diesel fuel per brake horse-power hour appears to be approximately one-fifth that of gasoline. Diesel engines, on the other hand, require more skilful and costly attention than do the spark-plug engines.

Relative costing is made and individual advantages are studied for steam prime movers, pumps, hoisting equipment, and rotating units in a similar manner to the above. Actual examples of problems to be solved in the choice of equipment are given by assuming certain conditions to exist. A. H. N.

438.* Mechanical Practicability of Electrical Logging While Drilling. D. G. Hawthorn and J. E. Owen. *Petrol. Engr*, January 1940, **11** (4), 71.—The basic plan behind the development of electrical logging while drilling was the use of the drilling-bit as the exploring electrode from which electrical readings might be obtained and recorded at the surface. To accomplish this it has been necessary to incorporate, as an integral part of the drill-stem, an electric circuit, and to insulate by suitable means the bit from the pipe. It was further necessary to provide recording apparatus and means for connecting this apparatus to the drill-stem circuit.

The electrical record taken while drilling is similar to any conventional electrical log, except that potentials and resistances are continuously measured and recorded on a meter while drilling is in progress. The chart is in plain view of the observer at all times. Formation resistance is recorded on the right and formation potential on the left. Both measurements are recorded against the well depth as the other co-ordinate.

The paper describes in detail the electric circuit and its testing, the constructional and mechanical features of the drill-stem, insulated electric terminals, insulated drill-collar, kelly and kelly sub, and miscellaneous equipment. Records are given of the behaviour of the equipment and the advantages accruing from its use. Drilling time is now affected to an almost negligible degree.

All advantages of using this method of electrical logging apply more or less to the drilling of wildcat wells and also to the drilling of proven structures that are unusually difficult to explore. The most important advantages of continuous electrical logging appear to be—

(1) it is an invaluable aid in conducting an intelligent coring programme;
(2) contact points and breaks in the formation can be instantly detected as the bit drills by;
(3) data that indicate the nature and characteristics of the formation being drilled are continuously and instantly available for subsurface correlation while drilling is in progress.

The availability of this information should be of great assistance in answering the many difficult questions arising in present-day deep exploratory well drilling (*cf.* abstract No. 246, 1940, for similar paper). A. H. N.

439.* December Spurt Brings Year's Drilling Near 1938 Level. L. J. Logan. *Oil Wkly*, 15.1.40, **96** (6), 12–14.—Statistics for drilling and completion activities in the U.S.A. are given for December 1939. Whereas drilling normally declines seasonably in December, it increased materially in the final month of 1939, further reflecting the brisk general business activity and the improved markets for refined products and crude oil.

Having expanded about 12% from the November proportions, field development in December was the greatest for the year. Well completions were the most numerous since November 1937, and thus were near all-time record level.

Records are given for average number of wells completed daily in U.S.A., by months from January 1933 to December 1939. A. H. N.

440.* More Drilling in U.S. Forecast for 1940. W. H. Strang. *Oil Wkly*, 29.1.40, **96** (8), 54–56.—The circumstances surrounding the industry as the year opens should

react to bring about the drilling in 1940 of 6·5% more wells than in 1939. Detailed studies of these circumstances show that 29,346 wells will be drilled during 1940. A. H. N.

441.* Rapid Expansion of Deep Drilling Continues. Anon. *Oil Wkly*, 29.1.40, **96** (8), 68.—A study is made of deep-well drilling over the past years, and data are shown both in tabulated and graphical forms. The number of tests carried to 10,000 ft. or more during 1939 is double the total of all preceding years. Indications are that 250 such operations will be drilled during 1940. A. H. N.

442.* Drilling Expenditures in 1940 to be Larger. B. Mills. *Oil Wkly*, 29.1.40, **96** (8), 84.—Cost analysis is made in various states and interesting figures are presented. Depreciation in the form of wear-and-tear is much greater than most operators realize. It is pointed out that the charge of only the amount of equipment used on and left at the well is incorrect, since depreciation of all equipment should be included. Many small equipment items will not drill more than one well, but others may drill a dozen wells.

Forecast for drilling expenditures for 1940 is made for various States of America. A. H. N.

443.* Average Well Depth Decreases in 1939. W. H. Strang. *Oil Wkly*, 29.1.40, **96** (8), 92.—A slight decrease in the average drilling depth in the U.S.A. is a significant feature of 1939 operations. Data are presented for average depths from 1925 onwards, and a comparative study is made of these figures. A. H. N.

444.* U.S. Drilling Above Average Level in 1939 Despite Drop. Z. H. Mischka. *Oil Wkly*, 29.1.40, **96** (8), 124.—Tables are given for drilling activities in the U.S.A. and a study of the trend of events is made. The completion of 28,274 tests in 1939 represents a decrease of 2·5% as compared with 1938; but this figure is still 28% larger than the average annual rate for drilling for the past decade. A. H. N.

445.* Increased Wildcat Drilling has Comparable Success. Anon. *Oil Wkly*, 29.1.40, **96** (8), 160.—A study is presented of wildcat activity and its results in the U.S.A. for the years 1938 and 1939. A. H. N.

446.* Rotary and Cable Tool Rigs Fulfil Divergent Needs. Anon. *Oil Wkly*, 29.1.40, **96** (8), 178–180.—A survey is presented of the rotary and cable-tool rigs in use in the U.S.A. Rotary rigs are in use in about 60% of drilling operations on January 1, 1940; cable-tool rigs constitute the remaining 40% of the total. A. H. N.

447. Drilling Patents. F. W. Hild. U.S.P. 2,186,139, 9.1.40. Appl. 9.1.37. Safety casing-head for permanently holding an outer casing and an inner casing in suspension and adapted to receive a temporarily superimposed drilling control column.

J. D. Hughes. U.S.P. 2,186,725, 9.1.40. Appl. 22.4.38. Straight-hole bit with blades on a body, one of the blades extending radially a greater distance than the others to create a greater unit area pressure on the low side of the bore being drilled when the bit is inclined from the vertical, thus reaming the low side of the bore and correcting the inclination.

D. C. Matthews. U.S.P. 2,186,875, 9.1.40. Appl. 27.6.38. Well-bore treatment during drilling consisting of forming a body of plastic setting material *in situ* in a well-bore above an uncased portion into which such material would normally dissipate while in plastic state.

A. L. Stone and A. E. Rice. U.S.P. 2,186,999, 16.1.40. Appl. 22.12.37. Oil-field power-plant.

C. H. Barnes. U.S.P. 2,187,007, 16.1.40. Appl. 29.3.38. Releasable cable-head, adapted to connect a cable with a well-tool, consisting of a case in which an enlargement at the end of a cable is held. The cable and case can be separated by exerting a predetermined tension.

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A. L. Armentrout. U.S.P. 2,188,589, 30.1.40. Appl. 22.5.39. Method for landing well-casings by putting it under tension, and then welding it at the head and removing the tensioning means.

G. E. Cannon and J. L. Foster. U.S.P. 2,188,767, 30.1.40. Appl. 25.7.36. Cement and cementing operation using Portland-type cement to which has been added a solution of caustic alkali and a material of the class consisting of humic, gallic, tannic, quercitannic, and lignic acids. A. H. N.

Production.

448.* Mixing Gases in Porous Media. R. Ducker and R. L. Huntington. *Oil Gas J.*, 4.1.40, **38** (34), 37.—Gas-recycling in distillate fields is necessary for three main reasons :—

(1) conservation of gas as fuel ;
(2) maintenance of a single-phase fluid within the reservoir ;
(3) driving the distillate-bearing fluid toward the producing wells.

The ideal situation would be one in which the dry gas would push the distillate-bearing fluid forward as a piston to the producing wells without mixing taking place in the pore spaces. Mixing actually does occur.

To determine the rate of mixing in porous media under static and flow conditions, small-scale tests were undertaken both for one- and three-dimensional flow, in which air and gas were allowed to diffuse in opposite directions through sand-packed tubes. The apparatus used is illustrated and the procedure followed described. Graphs are given of the results obtained, followed by a discussion and analysis of the data.

The authors' conclusions are that although the theory points out the likelihood of much slower diffusion between gases at higher reservoir pressures, it appears that the dilution of rich distillate gas with dry recycled gases will present a problem which must be solved lest the economic production life of a field be shortened due to high and prohibitive recycling ratios. Until a mass of data can be accumulated showing the effects of such variables as injection rate, well spacing, gas densities, permeabilities, porosity, etc., the empirical method of attacking the problem seems to be the logical approach. A. H. N.

449.* Improved Repressuring Plant in Titusville Field. J. P. O'Donnell. *Oil Gas J.*, 18.1.40, **38** (36), 36.—Core analysis revealed the fact that the saturation value was high enough to warrant the installation of a modern production equipment on an old lease near Titusville, Pa.

The paper describes a compact repressuring plant which has been installed and which has been progressively improved. Purchased electric power is used on this property. A. H. N.

450.* Repair Long String of Tubing under High-flowing Pressure. Anon. *Oil Gas J.*, 25.1.40, **38** (37), 201.—Indications of trouble in the world's deepest flush-producing well were given by the fact that the pressure on the oil string had continued to build up gradually, although in completion of the well two tubing-packers had been set at 11,200 ft. to seal off the extremely high bottom-hole pressure. The conclusion was that either the packers were not holding or that the tubing collars were leaking.

An attempt was first made to kill the well by pumping heavy mud through the tubing, and pressures up to 6000 lb./sq. in. were used. When the pumps were stopped, the well pressure would build up quickly to 4950. Other preliminary operations are described.

The trouble arose, it was found, from a hole which had been cut by well pressure in the tubing at a point between 4000 and 5000 ft., the mud being returned to the surface because of the jetting action caused by the hole.

Detailed description is given of the operations carried out in repairing the tubing. Ordinarily, in cases of tubing leaks, it might be possible to run a string of small pipe inside the 2½-in. tubing and kill the well, but in this case the tubing was found to be so crooked as a result of high pressure that it would have been impossible to get another string down. The operations were carried out with a drilling barge. A. H. N.

451.* Gas Condensate Well Important to Lisbon. G. Weber. *Oil Gas J.*, 1.2.40, **38** (38), 31–33.—Discovery of deep high-pressure gas-condensate production in Lisbon field of North Louisiana is of considerable engineering interest because of the thoroughness of its drilling record through the employment of advanced engineering principles.

Careful drilling was necessary due to the slim hole carried. Rotary speeds, choice of bits and fluid volumes were controlled to give a hole which never varied 1° off vertical. With ⅛-in. clearance through the 7-in. casing and total depth of 8900 ft., the test is believed to have required the deepest cementing job with the smallest clearance of any test to date.

A concise record of the well is given with drilling-time studies, electric logs, sample, gas-detector record, etc. The prospects of the pool are discussed. A. H. N.

452.* Bottom-hole Well Regulators. K. C. Sclater. *Petrol. Engr*, January 1940, **11** (4), 25–26.—One method of preventing or mitigating freezing in high-pressure gas wells on reduction of pressure is the use of removable bottom-hole chokes. This practice has been followed for years. The basis for its success is that the cooled gas draws heat from the walls of the well on its way to the surface. The method has its limitations, the chief one being that it is dependable only in gas wells, the rate of production of which is constant. A change in the rate of production means a change of choke, and consequently a pulling-up operation, with interruption in the flow of the well.

A bottom-hole regulator has been designed which works on the principle that a variable opening allows gas to flow at a constant pressure drop between its two sides. A spring-controlled valve automatically regulates the flow of the gas, so that the pressure on the exit side plus that due to the spring equals the pressure on the inlet side. A decrease in the inlet pressure-formation pressure means a decrease in flow, so that the pressure drop still remains the same. An adjusting ring adjusts the force exerted by the spring so that various limits of pressure variation may be dealt with effectively.

A diagram giving a detailed and clear section of the regulator both in the open and closed positions of the valve is included in the paper. While data are still inconclusive, it is believed that this regulator has a wide application, particularly in distillate production fields. A. H. N.

453.* Gas-lift Practice in West Texas Fields. H. L. Flood. *Petrol. Engr*, January 1940, **11** (4), 27–30.—West Texas, considered as a whole, embraces as great a variety of production phases as does any area comprised of old and new fields. This paper, however, deals mainly with gas-lift practice in fields where production has declined to 5 or 10 brl./day and where water/oil ratio may be as high as 1000 to 1.

The predominant characteristics of large fluid-volume wells in the Hendrick field is the high static level of the fluid, usually 200–250 ft. from the well-head. The working fluid level, however, is from 1200 to 1400 ft. from the well-head. Consequently an essential feature of any gas-lift installation must be the ability to kick-off the high fluid column and then produce efficiently the large volume of fluid. Flow-valves of the differential-, and velocity-control types have, therefore, been used extensively in this service.

Gas-lift in these fields is being practised extensively with installations ranging from conventional types to new applications, some incorporating new principles, others reverting to the earliest and simplest arrangements known. The methods selected in the paper represent the more interesting and representative methods in use.

Detailed diagrams and discussions are made of various intermittent operations and arrangements and types of packers. In certain instances throughout the West Texas area operators have been able, by suitably packing-off overlying gas sands, to use the energy of the gas to lift oil from the well either in continuous or intermittent flow—an operation termed "Braden-heading." A. H. N.

454.* Efficiency and Load Tests on Well-pumping Unit. B. Hopper. *Petrol. Engr*, January 1940, **11** (4), 38.—The object of these tests was to determine the relative merits of pumping unit of a conventional type, but designed

(1) with the tail-bearing below walking-beam on a centre line with the centre bearing;
(2) with the tail-bearing above the beam; and
(3) with the tail-bearing above the beam and the gear-box set back from its usual position.

Descriptions of the equipment and the testing procedure are given, with diagrams and photographs illustrating the different cases. The test results are tabulated. Typical polished-rod cards are reproduced.

The results of the tests indicate that the centre-line type pitman tail-bearing is the most desirable. It is found that the centre-line beam produced 12% more fluid than the unit having the tail-bearing above the beam at the same pumping speed, and almost exactly the same polished-rod stroke. This fluid was produced at about ½% more power/day; so that the cost in kw./brl. was 11·6% more for the bearing above the beam.

Comparing the centre-line type pitman tail-bearing assembly with the tail-bearing above the beam and the unit set back 8½ in., it is found that the centre-line bearing produced 21% more fluid at about 3% longer polished-rod stroke and the same speed. This fluid was produced at 6% more power/day; so that the fluid was produced with the bearing above the beam at more than 14% greater costs in kw./brl.

Other comparisons are made and advantages discussed. A. H. N.

455.* Proper Installation of Pumping Unit Essential to Satisfactory Service. K. N. Mills. *Petrol. Engr*, January 1940, **11** (4), 67–69.—The selection of a pumping unit of the proper size for a given well does not give complete assurance that the unit will render satisfactory service, because the service obtained from the unit will depend to a considerable extent on how the unit is installed and serviced. If the unit is properly installed, all loads imposed on it will be applied in the most favourable manner, and none of its members or bearings will be subjected to unnecessary loads incident to some installation errors. Similarly, the foundation bolts will not suffer unnecessary loads and possible failure.

One of the most common errors involving pumping-unit foundations is misalignment of the pumping unit relative to the well-head. Methods of avoiding such errors are detailed. Correct alignment of unit or foundation may be obtained by the use of bolt-templates and grout-sleeves. Diagrams illustrate a typical template, various faults in grout-pipes and aligning double- and single-crank installations.

The rules advocated here to obtain the proper installation of a pumping unit are all simple, and the cost of conforming to them is small when compared with the return received. This return will manifest itself in the form of lower maintenance cost and less loss of production due to shut-downs. A. H. N.

456.* Alignment Chart for Determining Pump Displacements as Related to Plunger Diameters. F. E. Hangs. *Petrol. Engr*, January 1940, **11** (4), 80.—Examples are given to illustrate the use of this simple chart. Pump speed, stroke, and number of plungers are assumed constant. A. H. N.

457.* Maintenance of High A.P.I. Gravities in the Production of Crude Oil. R. L. Huntington. *Oil Wkly*, 8.1.40, **96** (5), 10–13.—It is becoming increasingly appreciated by production engineers that conservation of the lighter fractions in crudes is important. In the first place, there is often a price differential between low- and high-gravity crude oils amounting to as much as several cents/brl. between one price-bracket and the other. Secondly, the loss of 1° A.P.I. gravity in most Mid-Continent crude oils results in a shrinkage of approximately 2½% by volume.

Such losses in gravity can often be prevented by (1) treating crude-oil emulsions at lower temperatures through the use of more chemicals or soap solutions, and (2) by proper separation and storage of crude oils.

An understanding of the principles governing vaporization and condensation is essential.

A case is cited whereby treating a crude oil at 130° F. instead of 110° F. the chemical treating cost was reduced from 0·2 to 0·1 cents/brl.; the gravity of the crude, however, dropped from 40 to 38° A.P.I., with a consequent loss of 5 cents/brl. on account of the 5% shrinkage and 2 cents/brl. due to the drop in gravity.

If the oil producer is compelled to use high-temperature demulsification, the loss of the lighter fractions can be prevented by using storage-tanks which will withstand several lb./sq. in. pressure.

The author then details certain of the more general principles of vaporization, solubility of lighter fractions in crude oils, and breathing losses of tanks. Raoult's Law is given, and a simple example on equilibrium flash vaporization is worked out for a gasoline fraction consisting of 40 mol.-% *n*-butane and 60 mol.-% *n*-pentane.

A. H. N.

458.* Paraffin Formation and Removal by Mechanical Methods in Pumping Wells. B. Mills. *Oil Wkly*, 8.1.40, **96** (5), 14–18.—The current study of paraffin in pumping wells involves several influences not recognized during earlier production periods: low formation pressures necessarily present in pumping wells, slow movement of oil in tubing, water, motion of the fluid, loss of temperature and mechanics as factors affecting pumping operations in typical paraffin-producing areas. Chemists are not in full agreement on the reasons for paraffin formation in tubing and surface equipment, since loss of temperature and loss of vapour from the oil each have a different importance to two schools of thought.

Experiments were conducted some time ago in East Texas to determine the relative importance of those two factors in light crudes. The results indicated that vaporization was a greater contributing factor than was originally thought. The author describes the experiments, but concludes that the experiments were not conclusive, as they did not represent accurately conditions existing in a pumping well.

Agitation tends to accelerate the accumulation of paraffin by causing small crystals to unite. Vicinity of a water-sand helps materially to accentuate paraffin deposition at certain points in the tubing. An oil–water emulsion sometimes increases the accumulation of paraffin. Free water often minimizes the formation of paraffin, particularly where it has a temperature above 90° F.; if it is allowed to remain and cool in the upper part of the tubing, water, however, often accelerates formation of paraffin. Loss of gas from the crude, on reduction of formation pressure, is a major cause of paraffin deposition at low points in the tubing. Presence of foreign matter in the crude has increased paraffin trouble in several fields. The action of paraffin in oil indicates that it will not ordinarily go back into solution when the temperature at which it precipitated is reached. The principles of the mechanisms of all these facts are explained in the paper.

Mechanical removal of deposited paraffins is next described. Cutting, scraping, drilling out, and swabbing methods are being used extensively where the accumulation of paraffin has seriously retarded normal pumping production. Use of steam has declined, but many operators are still trying to find a way of forcing steam to the seat of the trouble.

Detailed drawings give the use of a simple go-devil scraper; but various other methods are also fully described.

A. H. N.

459.* Disposal of Oil-Field Brines. M. J. Leahy. *Oil Wkly*, 8.1.40, **96** (5), 19–24.—Many oil producers are attempting to dispose of their salt water as it accumulates on the surface by pumping it into a water stratum lying below the oil-producing horizon. There are two general methods in use. The first consists of gathering all brine into one central reservoir and then pumping it into a specially drilled brine-input well at the edge of the reservoir. The second method is to pump the brines from smaller areas into an abandoned well incapable of producing its allowable. Both methods are extremely costly; the first for drilling and maintenance expenses, the second for the cost of a complicated aerating system necessary to avoid plugging the formations by precipitates.

The author puts forward five methods for the utilization of oil-field waters which show some possibilities.

The first method utilizes a special waste-gas burner which burns under water, and thus, by submerging the burner in a vat, the water is evaporated, leaving a black, vitreous mass of high strength both in compression and tension, and which is very difficult to fracture or to grind. It is suggested that if a market be found for this new fused material the process will yield a dividend.

The second method is a modification of the first where woven glass blankets are used in the flues of an oven using these burners and suspended over the brine. Rapid evaporation results in accumulation of sodium chloride and complete loss of water.

The third method is a chemical double decomposition one, and consists, in principle, of forming the two insoluble salts, sodium bisulphite and lead chloride. Lead sulphite is dissolved in strong hydrochloric acid and the solution is added to the cold brine, the insoluble salts precipitated quickly—without excess of hydrochloric acid. The advantages and practical difficulties of the process are discussed.

The fourth method is simply the reverse of the base-exchange method commonly used for softening hard water. In the final form the method was elaborated into passing oil-field brine through a column of artificial sodium–copper zeolite, and the liquid leaving the tower was essentially a cupric chloride solution. This liquid was treated with sponge copper, which quantitatively precipitated all the cupric chloride as cuprous chloride, leaving the water in a very pure state.

The fifth method is a complicated arrangement of methods 4 and 3.

In the summary a study is made of the economics of salt recovery and brine disposal. A. H. N.

460.* Electrified Lease. W. C. Lane. *Oil Wkly*, 8.1.40, **96** (5), 26.—The case of a lease which gave a remarkable record of 10 years' service after it was electrified mostly by salvaged material is described. The record shows very little trouble in all respects and negligible time lost due to shut-downs. It is believed that the feature most responsible for the successful operation of the wells is the use of high-slip motors to provide the power for the seventeen pumping wells. The only cases of motor trouble experienced were due to lightning and a broken gear-shaft. When a 5-h.p. high-slip motor was replaced by a 7½-h.p. motor of the industrial type for temporary use, the higher-rated motor burned out before the great difference in the load characteristics of the two types of motors when subjected to pumping loads could be realized. As an instance of the better adaptability of the high-slip motor for work of this type a case was cited in which it required 8 min. for a motor to bring a well up to speed. It is believed that no industrial-type motor could stand such abuse and remain in service for 10 years. A. H. N.

461.* Repressuring Successfully Retards Water Encroachment. J. C. Albright. *Oil Wkly*, 8.1.40, **96** (5), 32–33.—Repressuring projects are usually initiated to accelerate the production recovery of a sand which has already produced a considerable quantity of oil, but the application of this process for the purpose of retarding or controlling water encroachment is being used successfully in at least one instance.

Detailed production record is given of this particular instance where not only have the repressuring operations increased the oil yield, but the water output has at the same time been materially reduced. The effect of repressuring on water encroachment was all the more remarkable as, according to the author, it was almost instantaneous. A. H. N.

462.* Chemical Removal of Paraffin from Pumping Wells. G. F. Williams and F. N. Alquist. *Oil Wkly*, 15.1.40, **96** (6), 22.—Chemical removal of paraffin is definitely a method past the experimental stage. The first attempts were confined to the use of natural derivatives of oil and to oil itself to dissolve the paraffin. These methods are now abandoned, chiefly because the solvents are of low specific gravity, which fact prohibits proper contact with the deposited paraffin. More successful methods utilize a mixture of a heavy commercial solvent with a light carrying agent, so that the specific gravity of the mixture is from 0·9 to 1·1.

The major advantage of using solvents is the ability to apply them to pumping wells without pulling-rods or tubing.

In the first of two types of wells in which solvent is used considerable gas is pumped

with the oil. On releasing the back pressure in shutting down such wells, a quantity of oil is pushed up out of the tubing. In such a case the most effective method of applying solvents has been found in removing the stuffing-box and pouring a heavier-than-oil solvent down the tubing.

In the second type of pumping wells there is insufficient gas produced with the oil to unload the tubing. Three methods may be used in such a well.

The first method aims at lowering the head in the tubing by letting the oil out at the lower end. The standing valve is lifted, the oil seeks its own level, and the solvent is introduced into the tubing; the solvent, being heavier than the oil, sinks to the bottom.

The second method utilizes 25 ft. of copper tubing, the lower end of which is closed and perforated, run down the well inside the tubing beside the rods. The solvent is poured down a funnel, displaces the oil at the top of the tubing, and on sinking dissolves the paraffin. The solvent should be heavy—of 1·25 specific gravity.

The third is a circulation method in which the solvent is introduced into the well by a lubricator through the casing at the casing-head. The well is not shut down, and paraffin is removed from the sand-face, as well as from the tubing, as the solvent is pumped out. The method is used regularly—say, weekly or monthly. The solvent used in the circulation method should be only slightly heavier than the crude, so that it sinks to the bottom of the well and yet does not stay there indefinitely, but rises through the tubing with the inflow of oil.

Variants of this method and details of application are given in the paper. Diagrams and photographs illustrate the connections at the well-head and procedure to be followed. A. H. N.

463.* Repressuring Showing Quick Profit. Anon. *Oil Wkly*, 15.1.40, **96** (6), 28.—The advantages of intelligent application of repressuring are demonstrated in one pool where a $100,000 repressuring plant is sustaining itself while returning the investment at a rate greater than $120 per month. In addition to these measurable advantages, it is estimated that the plant will eventually bring to market 30–50% more oil.

The pool produces through fifty-seven wells from two sands at 2400 and 3000 ft., respectively. Because of the diversity of ownership in the pool, the first step was the formulation of a unitization plan. This was completely successful.

The key, or input, wells were selected from the original producers and cleaned of all sand and sediment to the bottom of the hole. Two types of control-heads, both illustrated, were designed. The first was for use where the gas was injected into only one sand through the annulus; the second was used where gas was introduced to both sands through tubing and annulus. Injection into the upper sand required a gas pressure of 310 lb./sq. in.; injection into the lower sand 325 lb./sq. in.

The pumping wells were all connected to centralized lease batteries equipped with separators to recover all the gas at these points, obviating the expensive network of lines necessary to connect each casing-head.

Illustrations are given for producing well connections, compressors, intake pipings, etc. Details of plant layout are outlined. A. H. N.

464.* Influence of Submergence and Fluid Level on Pumping Wells. H. Huffman. *Oil Wkly*, 22.1.40, **96** (7), 16.—In any pumping well there are four factors which determine the amount of fluid which will be produced :—

(1) the fluid level maintained in the casing;
(2) the submergence of the standing valve;
(3) the displacement of the pump;
(4) the reservoir pressure.

The paper deals with the first two items only.

A discussion is given of the advantages and disadvantages of maintaining high fluid levels and high submergence in the well. In general, the high fluid level produces the well under sounder and more economical conditions than low levels, but at the same time it is reducing the rate of production by the pressure it exerts on the sand. The effects of fluid levels on gas/oil ratios, sand, and excessive water intrusion are

detailed. When due consideration is given to the numerous factors involved in the determination of the best fluid level, it is shown that the production of two or more horizons through one well does not allow the most scientific means of production to operate.

As the reservoir pressure of a well declines, submergence, through its effects on valve action, becomes increasingly important. The quickness with which the standing valve opens at the start of the upstroke is a function of the pressure on its underside, which pressure is a function of submergence. Thus volumetric efficiency becomes a function of submergence. Graphs as well as a detailed discussion of what occurs on the commencement of the upstroke fully explain this statement.

It frequently happens that when the number of strokes/minute is increased, the actual increase in production does not correspond to the theoretical increase based on calculations of plunger displacement. To explain this, it must be assumed that the barrel is not filling up as much on the faster stroke as on the slow one. After a study of the conditions operating on increasing the number of strokes/minute it is seen that any increase in pumping speed must be accompanied by an increase in submergence in order to obtain the same volumetric efficiency.

The use of the inverted pump—in which the plunger is stationary and the barrel reciprocates—is discussed. There are cases where production of low-pressure wells has been increased by several barrels by converting the inverted pump to the standard type.

As reservoir pressure decreases the use of long gas anchors becomes unnecessary, and sometimes harmful. Submergence becomes of increasing importance. In such cases the long anchor should be reduced and submergence increased. The increased production would pay many times over for the expense of pulling-rods and tubing.

A. H. N.

465.* World Production Sets New Record. Z. H. Mischka. *Oil Wkly*, 29.1.40, **96** (8), 49–51.—World production of petroleum set up a new record of 2,080,498,000 brl. in 1939, and every indication at the turn of the year pointed to an even greater figure for 1940.

A complete production history of the world is given in tabulated form under headings of different countries and year by year from 1857 to 1939 inclusive.

A short study is made of the production of various countries in 1939 as compared with the preceding years. A. H. N.

466.* Sharp Increases in Pumping Installations Indicated. B. Mills. *Oil Wkly*, 29.1.40, **96** (8), 80.—A survey is made of pumping wells and of those which are to be put on the pumps in 1940 in the U.S.A. It is estimated that 15,358 wells will go on the pump during 1940, requiring $25,000,000 worth of new equipment.

A. H. N.

467.* U.S. Production Should Reach New Peak in 1940. Anon. *Oil Wkly*, 29.1.40, **96** (8), 147.—Apart from the forecast for 1940, this paper is interesting, as it presents a complete production history of the U.S.A., under the headings of various states for the years 1859–1939 inclusive. Special studies are also made of the production trend in various States. A. H. N.

468.* New Plan for Setting Well Potentials. W. R. Wardner, Jr. *Petrol. World*, January 1940, **37** (1), 29.—This long paper deals with information gained from subsurface pressure measurements in the determination of well potentials. Such measurements relate the condition of flow to well productivity in a more satisfactory way than estimations of well capacities can be made from surface production data.

The reasons for adopting bottom-hole pressure measurement in evaluating potentials are summarized as :—

(1) to establish a uniform yardstick to apply to all wells in evaluating their productivity under restricted flow;

(2) to permit a more exact evaluation of well decline factors under restricted flow;

(3) to minimize waste and eliminate many evils of the open flow test;

(4) to eliminate excess production and over-taxing marketing outlets, and thus necessitating shutting down other wells to offset the excess made by the well under open flow test;

(5) to reduce investment in over-sized equipment.

Similarly the data, which are invaluable in analysing production problems, and some of the more important factors are summarized. Such factors are: (1) initial reservoir pressure; (2) productivity index; (3) depth of fluid level in tubing and between tubing and casing; (4) depth to which well should be tubed for most effective and efficient operation; (5) depth to which hole is open to production and portion filled by sand; (6) the time to discontinue gas lift and instal pumping operations; (7) efficiency of pumping operations; (8) amount and pressure of input gas for gas-lift; (9) data for the studies of the reservoir, such as position and extent of the gas-cap, drainage across property lines, pool reserves, pressure maintenance, and other related subjects.

Methods for bottom-hole pressure determinations are given in detail. The sonic method of using the height of the fluid within the pumping well as a measure of the pressure is illustrated by graphs, and photographs, and actual examples are worked out. The fundamental assumptions in using this method are discussed.

The use of bottom-hole pressure-recorders is similarly illustrated: sections of the Standard depth-pressure recorder and the Amerada instrument are given. Examples of sub-surface pressure tests on flowing and pumping wells are worked out in full, accompanied by typical graphs and numerical values.

Potential factors are calculated by the use of the two methods for pumping wells and of the recorder method for a flowing well. The sonic method is only adaptable to a pumping well. A. H. N.

469.* Problem of Oil-Mining at Egbell (Slovakia). J. Brož. *Oel u. Kohle*, 1.12.39, **35** (45), 765–767.—The north part of the new field at Egbell still contains considerable reserves, but the south part of the new field and the old field have been well drilled and are relatively well known. It is estimated that about 720,000 tons of oil could be extracted by mining, without taking into account the new field. Conditions are favourable for mining, folding being very gentle and the main tectonic disturbances of the nature of block-faulting. Abnormal gas and water pressures are absent, and the field has been well degassed by drilling. The oil-sand stands up under pressure and does not flow; there are no running-water sands above the oil-sand. The thickness of the oil-sand is reasonable, and there is no marked lateral variation. Finally, the dip, although gentle, is sufficient to promote drainage, and the physical properties of the sand are also favourable from the same point of view. S. E. C.

470. Effects of Acid Treatment upon the Ultimate Recovery of Oil from some Limestone Fields in Kansas. R. E. Heithecker. U.S. Bureau of Mines, Report of Investigations, No. 3445, April 1939.—In Kansas it is current practice to treat almost every well drilled in the limestone formation with hydrochloric (muriatic) acid on completion. This, besides increasing daily production, shortens the time required to recover the oil, and moreover materially extends ultimate oil recovery from each well. In certain circumstances acid treatment of wells is even believed to have extended productive limits of limestone fields in Kansas. After such treatment edge-wells showing only small quantities of oil have yielded commercial quantities and have been completed as large oil-wells, whether or not they have been shot with nitroglycerin.

Hydrochloric acid treatment was first used in Kansas in October 1932: by the end of 1934, 944 wells had been treated, and by the end of 1937, 5824 wells. In addition, certain wells were treated more than once, thus bringing the total number of treatments by the end of 1937 to 8070.

With experience certain modifications of the original treatment have been made, it being claimed, for instance, that better results are obtained by mixing chemicals with the acid. Choice of these chemicals is dependent on the area involved and the particular conditions obtaining. In many instances also stage or multiple treatments have proved more effective than the practice of putting all the acid in the well at the same time.

Further research is needed to determine more accurately quantities of acid required and optimum rates of injection. 1000 gal. of 15% acid have in some wells proved more efficient than much larger quantities in adjacent wells, the theory being that too much acid damages the reservoir and even penetrates below the bottom of the well into water-bearing strata. H. B. M.

471. Production Patents. E. E. Johnson. U.S.P. 2,185,999, 9.1.40. Appl. 2.4.35. Process for making screens for use in connection with oil wells.

W. E. Niles. U.S.P. 2,186,035, 9.1.40. Appl. 30.6.38. Method of and apparatus for flowing wells consisting of a tubing extending to the pay, a packer and a heater carried by the tubing in the upper portion of the formation for heating a certain portion of it to generate pressure in the lower portion of the formation, and thus effect flow of petroleum through the formation and tubing to the surface. The patent covers also use of insulating the heater from the flow of moving fluids in the tubings. Back-pressure valves are used.

R. A. Albert. U.S.P. 2,186,151, 9.1.40. Appl. 11.5.39. Sucker-rod rack made of a hooked shaft carrying a conical hollow metallic support having radial slots for reception of sucker-rods.

W. L. Bald. U.S.P. 2,186,230, 9.1.40. Appl. 11.8.38. Hydraulic oil well-packer.

B. Travis. U.S.P. 2,186,309, 9.1.40. Appl. 12.10.38. Rotary washer for casing perforations.

C. C. Brown. U.S.P. 2,186,323, 9.1.40. Appl. 5.4.37. Casing perforator for formation testing consisting of exploding a charge below a packer in a body designed to direct the force of the explosion at certain points in the casing.

C. C. Brown. U.S.P. 2,186,324, 9.1.40. Appl. 26.11.37. Packer and setting-tool combination.

J. T. Simmons. U.S.P. 2,186,349, 9.1.40. Appl. 9.1.37. Method for acidizing wells without affecting the strata below the one to be treated. Packers are used.

J. M. Gurley and A. M. Gurley. U.S.P. 2,186,411, 9.1.40. Appl. 22.4.37. Deep-well hydraulic pump.

M. O. Johnston and W. F. Bettis. U.S.P. 2,186,488, 9.1.40. Appl. 15.4.37. Means of regulating flow of fluid within a well.

G. T. Pfleger. U.S.P. 2,186,494, 9.1.40. Appl. 6.12.37. Submersible electric motor.

P. M. Sieck and R. M. Holloway. U.S.P. 2,186,886, 9.1.40. Appl. 19.5.38. An air-lift system.

J. N. Ice. U.S.P. 2,186,974, 16.1.40. Appl. 10.6.38. Pipe, tubing, and conduit coupling.

K. H. Miner. U.S.P. 2,187,047, 16.1.40. Appl. 22.5.39. Means and method of sampling well-fluid consisting of a combination of gun-perforator and sample-taker, the perforator breaking open the sealed chamber of the sampler.

A. N. McLennan. U.S.P. 2,187,278, 16.1.40. Appl. 12.1.37. Means for locating and cementing off leaks in well-casing consisting of perforated tubings and two packers to locate the cement and means for removing it from the annular space between casing and instrument without moving the latter.

C. E. Burt. U.S.P. 2,187,486, 16.1.40. Appl. 12.12.38. Formation-testing method and apparatus.

J. W. Chambers. U.S.P. 2,187,679, 16.1.40. Appl. 8.10.38. Deep well pump having multiple cylinder-and-piston arrangements and being driven by a motor through a system of gearing and crankshafts for each piston.

A. J. Penick and K. T. Penick. U.S.P. 2,187,839, 23.1.40. Appl. 7.3.38. Casing-head.

A. J. Penick. U.S.P. 2,187,840, 23.1.40. Appl. 9.7.38. A seating-tool for lowering a tubing hanger.

E. Tatalovich. U.S.P. 2,187,845, 23.1.40. Appl. 14.8.39. Clean-out tool for oil wells.

C. S. Sanders. U.S.P. 2,187,895, 23.1.40. Appl. 28.3.38. Method of forming a porous concrete well strainer *in situ* by introducing concrete between a productive formation and a well, and then subjecting the concrete to the action of a material having a selective solvent action on one constituent, thus rendering the concrete porous.

R. B. Prentice. U.S.P. 2,188,119, 23.1.40. Appl. 3.3.39. Centralizer and protector for an oil-well string.

J. S. Abercrombie. U.S.P. 2,188,141, 23.1.40. Appl. 10.6.38. Tool-joint control for blowout preventers.

G. H. Pfefferle. U.S.P. 2,188,302, 30.1.40. Appl. 27.9.38. Means for stopping leaks in pipe-lines.

C. E. Black. U.S.P. 2,188,425, 30.1.40. Appl. 20.10.38. Trap for the polish rod of a pump.

T. A. Larry and E. E. Clive. U.S.P. 2,188,607, 30.1.40. Appl. 16.11.36. Method of making lateral extensions from pipe-lines.

S. A. Guiberson. U.S.P. 2,188,656, 30.1.40. Appl. 28.9.36. Means for flowing wells by gas-lift utilizing two packers and perforated tubing to form a pressure-chamber at the well-bottom.

F. A. Thaheld. U.S.P. 2,188,668, 30.1.40. Appl. 30.3.36. Means for flowing wells by gas-lift, utilizing tubings, packer, and a regulator in form of piston and valve at bottom, in order to adjust rate of flow of lifting fluid.

H. W. Hixon. U.S.P. 2,188,737, 30.1.40. Appl. 26.4.39. Apparatus for recovering oil from subterranean oil pockets by means of injecting air and gas, through two concentric tubings and igniting the charge at well-bottom, and thus pushing oil into formation towards surrounding producer wells. A. H. N.

Transport and Storage.

472.* Comparison of Methods for Estimating Soil Corrosivity. K. H. Logan and E. A. Koenig. *Oil Gas J.*, 17.11.39, **38** (27), 130.—For this particular study soil corrosivity is defined as its power to impair a pipe. Consideration is given to the methods usually adopted to classify pipe as criteria of the corrosiveness of soil. The maximum pit depth on the joint adjacent to the point where the soil sample was taken was selected as the criterion of soil corrosivity in considering the merits of methods for the direct measurement of this property. Other methods considered gave similar results and showed no preponderant advantage over the one selected. A number of methods for the direct measurement of soil corrosivity have been examined, viz. :—

1. Measurement of soil resistivity by Shepard's resistivity meter, the meter used being designed to minimize polarization.
2. Measurement of the total acidity. In this connection P_H value was not considered to be a satisfactory measure of soil corrosivity, as it does not indicate the total available acidity.
3. Acidity–resistivity test involving an equation in which acidity and resistivity are represented. This method does not classify soils of low acidity, and two-thirds of the soils examined were placed in one group.
4. The Columbia rod test, involving measurement of the current between two electrodes, one of ferrous and one of non-ferrous metal, with the soil under test packed between them.

5. The Putnam test, in which consideration is given to soil/pipe potential and polarization as well as resistivity. It consists of measuring the current which will flow across a 1-in. cube of soil subjected to a potential of 1·4 volts.

6. The nipple-and-can electrolytic test which the loss in weight of a 3-in. length of steel pipe caused by the passage of current at 6 volts. The pipe is surrounded by saturated soil in a can 3 in. in diameter.

7. The Denison electrolytic test in which soil corrosivity is determined by the relation between current density and potential in a cell in which the anode is a steel disc and the cathode a steel screen.

Comparison of the methods examined with a record of maximum pit depth are given in detail. It is concluded that all the methods are of definite value in determining corrosivity and give a reasonable degree of accuracy for the corrosiveness of a soil series. The relative merits vary with the type of soil—*e.g.*, the test best suited to alkaline soils might not be the best for acid soils. R. J. E.

473.* Co-operative Problems Involved in Cathodic Protection. L. F. Scherer. *Oil Gas J.*, 17.11.39, **38** (27), 179.—A summary of the history of the application of cathodic protection is provided. A survey of the extent to which cathodic protection has been applied and of the various methods of protection in use carried out by the Mid-Continent Cathodic Protection Association indicates the rapid development during recent years. The aims, accomplishments, and limitations of the Association are discussed in detail. It is held that the increasing recognition and application of cathodic protection call for organization and standardization of the technological work carried out on this subject.

A major problem is the allocation of responsibility in cases where two or more pipe-lines are involved. Up to the present such problems have been solved by friendly co-operation or arbitration, but the need for establishing precedents and rules of procedure is stressed. It is suggested that the American Petroleum Institute is peculiarly suited to act as a medium through which the growing technological work on this subject may be organized and studied with particular reference to such problems as standard terminology, recommended standards on methods and equipments, and kindred problems. R. J. E.

474.* Internal Corrosion of Gasoline Pipe-Lines. L. C. Morris and W. A. Schulze. *Oil Gas J.*, 17.11.39, **38** (27), 205.—Investigation of the causes of internal corrosion of pipe-lines has shown that air and entrained water containing dissolved or suspended materials arising from chemical refining are the principal causes of corrosion. A turbidimeter, based on the measurement of the light from a standard source passing through gasoline, is used to give a measure of the aqueous solution and solids suspended in the gasoline. To explore the possibilities of corrosion inhibitors, laboratory corrosion tests simulating pipe-line conditions have been evolved. These tests revealed that natural inhibitors believed to be cresols and naphthenic acids are present in cracked gasoline. Salts arising from doctor treatment,—*e.g.*, lead sulphide and sodium through sulphate—were found to be corrosion accelerators, whilst non-reactive solids localized the corrosion. Increasing velocity of flow resulted in more uniform but less severe corrosion, and increasing temperature accelerated corrosion.

Of many chemicals tested, mercapto-benzothiazole was found to be the most effective inhibitor, and was tried out in a pilot plant under conditions which ensured that the only difference between test and control was the presence of inhibitor. These trials showed that a concentration of 1–2 lb. of this inhibitor per 1000 brl. of gasoline gave the most satisfactory protection. Moreover, the inhibitor had no deleterious effect on the properties of the gasoline.

In application to a pipe-line the mercapto-benzothiazole is introduced into the gasoline in the form of a slurry with flushing oil. Equipment for this purpose is described. The life of the inhibitor has been found to vary with the nature of the gasoline and the method of sweetening. To determine the length of pipe-line, protected steel-test pieces—inserted at selected intervals—are periodically examined; their condition gives an indication of the protection afforded to the pipe-line. Delicate methods for estimating the amount of mercapto-benzothiazole in gasoline have been

evolved and used to indicate the point in a pipe-line at which the inhibitor is exhausted. R. J. E.

475.* Graphic Interpretation of Evaporation Losses from Vented Tanks. R. F. Larson and J. A. Goff. *Petrol. Engr*, November 1939, **11** (2), 42.—An independent method is described of developing the formulæ used for the calculation of evaporation loss from vented storage-tanks described by W. F. Rogers, *Petrol. Engr*, June 1938, p. 39, and July 1938, p. 48. The analysis is based on the following assumptions: (1) a definite vapour-pressure curve, (2) complete saturation at all temperatures, (3) negligible changes in the volume of the vapour space, and (4) applicability of the perfect gas laws, and therefore of Dalton's law. An illustration is given of the application of the formulæ to the evaporation loss from a West Texas crude in a 80,000-brl. tank under definite conditions. It is realized that the assumptions may not necessarily be valid and, in addition, no account is taken of time required for diffusion of oil vapours and of air which, in periods of very rapid temperature rise, may seriously affect the actual loss of vapour. C. L. G.

476.* Protective Coatings for Hydrocarbon Containers. A. Foulon. *Oel u. Kohle*, 1939, **33**, 647.—Concerns prevention of corrosion in hydrocarbon containers in transport and storage by use as lacquers, resins, concentrated drying oils, or solutions of condensation products of polybasic acids. For benzine, benzene, and similar petroleum liquids these lacquers must be prehardened at a temperature above 100° C. to prevent softening and solution. Protection of the container by incorporation of protective metals and protective oils of special properties is discussed. A. V. B.

477. Filling Stations for Liquefied Gas. W. Salnikoff. *Brennst. Waermewirt.*, 1939, **21**, 195–198.—Refueling of vehicles driven by liquefied gas has usually been effected by changing the containers. It is, however, possible to store the gas in large containers at filling-stations and to feed it into the cars, as in the case of petrol. Such a filling-station is described in detail, and it is stated that several of them are already in operation in Germany. The gas is lifted from the lower floor, not by plunger, but by an injector. The standard station fills the containers of a lorry, 70 kg. in 3–4 min. The plant in the Central Garage of the Berlin buses fills 200 litres/min. As liquefied gas in Germany is not considered to be merely an emergency fuel, the filling-station of the kind described will be cheaper in the long run than the operation of changing containers. E. W. S.

478.* Cleaning of Plant Handling Tar, Bitumen, Heavy Oil, and other Viscous Materials. K. S. Low. *Fuel Econ.*, 1939, **15**, 339.—The cleansing of vessels and appliances which have contained viscous, glutinous, or film-forming materials usually involves considerable expenditure of time and labour. The author has witnessed the capabilities of a new appliance which it is claimed has reduced cleaning time from days to less than ½ hr. The appliance is the "Desolvator." This is essentially a pressure vessel of about 70 gal. capacity containing heating coils. A quantity of solvent, suitable for the cleaning operation required, is heated in the vessel, and the pressure developed is utilized to spray the solvent under high pressure on to the walls of the plant or vessel to be cleaned.

In the test observed by the author, a 14-ton tank car in very bad condition, having been in use for tar, was effectively cleaned in 20 min. T. C. G. T.

Crude Petroleum.

479. Properties of Louisiana Crude Oils. II. Additional Analyses. E. L. Garton. U.S. Bureau of Mines, Report of Investigations, No. 3476, November 1939.—This report contains the results of analyses of 72 samples of crude petroleum from 45 oil-fields in Louisiana. It begins with a brief history and production data for each field from which the appropriate samples were derived. The analytical data are compared and discussed, and it is shown that of the 47 crude-oil samples from Northern Louisiana, 28 are classifiable as paraffin base, 9 as paraffin-intermediate, 6 as inter-

mediate, and 4 as naphthene-intermediate. Of the 25 samples from Southern Louisiana, 2 are paraffin base crudes, 4 paraffin-intermediate, 12 intermediate, 2 intermediate paraffin, 4 naphthene-intermediate, and 1 naphthene. Production from Southern Louisiana is from greater depths than in the northern division, and the oil is more often associated with salt-dome structures; these facts are reflected in the comparative analyses, which indicate that intermediate base crudes predominate in the south, whilst the tendency is for paraffin base oils to characterize the northern fields. H. B. M.

Gas.

480.* Improvement in the Calorific Value of Town's Gas or Coke-Oven Gas with Reference to Utilization as a Fuel for Motor Vehicles. J. I. Graham and D. G. Skinner. *J. Inst. Fuel*, 1939, **13** (69), 39.—The chief drawback to the use of compressed coal gases is the great weight of container relative to that of fuel (ratio 10 : 1). A 32-seater bus can carry 7 cylinders each weighing empty 1 cwt. and holding 350 cu. ft. of gas at 200 atm. pressure, thus giving a range of about 80 miles per filling, the quantity of gas of 475 B.T.U. per cu. ft. equivalent to 1 gal. of petrol being taken as 265 cu. ft. The thermal efficiency with coal gas is greater than with petrol, but it is necessary to increase the compression ratio in order to obtain a power output at least equal to that when petrol is used. Coal gas costing 2*d*. per therm could be supplied compressed to 3000 lb. in cylinders at a figure equivalent to 6*d*. per gal. of petrol, if the offtake were equivalent to 1200 gal. of petrol daily. The highest item is the cost of compression, which is independent of the calorific value of the gas. For this reason a gas of higher calorific value—*e.g.*, methane (895 B.T.U.'s/cu. ft.)—would be preferable. Attempts have been made to obtain methane from coal-gas by preferential adsorption on active charcoal, but the maximum concentration available in the presence of CO_2 was 44·5% with 27% of CO. Further methane can be obtained by catalytic conversion of CO or by catalytic combination of CO with the H_2 in coal-gas. Gas prepared by this method has been tested on the road in a 12-h.p., 4-cylinder car, a consumption of 13·2 cu. ft. per hour being obtained, compared with a figure of 25 cu. ft. for ordinary coal-gas. During normal running conditions combustion was much more efficient than with petrol, practically no CO being formed, as compared with 6·7% for petrol. The cost of untreated coal-gas compressed to 200 atm. is estimated at 9·2*d*. per equivalent gal. of petrol (at gas 4*d*. per therm), and that of catalytically produced methane (excluding the cost of the catalytic process) at 8·92*d*. The increased mileage obtained for the same cylinder weight as compared with coal-gas should permit of an appreciable expenditure on the catalytic process. By mixing blue water-gas with town-gas in proportions of 1 : 5, the cost of the process should be considerably reduced and a gas of approximately 10% higher calorific value obtained. It is also possible to obtain a gas by the catalytic treatment of coke-oven gas which contains 47% CH_4 and 42% H_2, and on further concentration by the adsorption method a gas of calorific value nearly 900 could be obtained. A mixture of 80% CH_4 and 20% C_2H_6 would be of still greater importance, having a calorific value of about 1140 B.T.U.'s per cu. ft. C. L. G.

481.* Refinery Gas : a Raw Material of Growing Importance. R. E. Wilson. *Chem. and Ind.*, 1939, **58**, 1095–1101.—Gas from cracking to-day amounts to 7—8% by weight of the total crude run in the U.S.A. This proportion amounts to about 940 million cu. ft., or 14 million tons per year. The refinery gas referred to in the article is this cracked gas.

About 75% of an up-to-date refinery gas consists of C_4 hydrocarbons (boiling 14–39° C.) and 80% of these latter are stabilized in gasoline. It is common practice to have as much as 7% butanes in summer-grade gasolines and 12% in winter grades.

Attention is directed to the fact that one of the greatest objections to the use of alcohol in gasoline is that the addition of alcohol tends to increase the vapour pressure of the gasoline very substantially, and thus to reduce the amount of butane which might be incorporated. Since butanes are far cheaper and better than alcohol as a constituent of gasoline, either from an anti-knock or other standpoint, the addition of small amounts of alcohol does not increase either the quality or the quantity of the gasoline available, although it greatly increases the cost.

Propane is now established as one of the most efficient solvents for the removal of wax, asphalt, and heavy ends from lubricating oil. Propane owes its versatility as a precipitant largely to the fact that its solvent properties change rapidly over the convenient temperature range between its b.pt., — 44° F., and its critical temperature, 212° F. For instance, its density falls from 0·5 to 0·25 in this temperature range.

Apart from its growing use in solvent refining, 150 million gal. are used every year as bottled gas, etc.

The development of refinery gas as a raw material for the chemical industry dates from about 1921, when *iso*propyl alcohol was produced from propylene with an eventual reduction in the price of the alcohol from $7 per gal. to one-twentieth of that price. The progress of this field is traced through ethylene dichloride, chlorhydrin, and glycol to the present day, when one company is making commercially more than one hundred synthetic chemicals, starting from ethylene, propylene, and the butylenes. This list includes 24 alcohols and alcohol ethers, 4 ketones, 23 esters, 14 amines, 8 ethers, and 7 chlorinated compounds.

Practically all the *iso*propyl alcohol and *sec.*- and *tert.*-butyl alcohols on the market to-day are made from petroleum gases, and most of the acetone is made by the catalytic dehydrogenation of *iso*propyl alcohol.

Dichlorides are readily obtained, and ethylene dichloride from refinery gas is becoming of great importance. It is used in the preparation of the rubber substitute, Thiokol, whilst vinyl chloride is made from ethylene dichloride, and is of great importance as the starting-point in the preparation of the polyvinyl resins.

Butylene can be dehydrogenated to butadiene, and this in turn, is polymerized to "Buna" rubber.

Glycerine can be made by the regulated chlorination of propylene, followed by hydrolysis. This synthesis is of topical interest, as in the case of excessive demand of glycerine during war periods the process may be developed.

The paraffinic gases are not directly useful for such syntheses, but the olefinic gases required are normally prepared by cracking or the catalytic dehydrogenation of the paraffinic gases.

Numerous other synthesis of interest to the chemical industry are instanced.

While the above-mentioned processes are of great importance to the chemical industry, they are not of such great moment in the petroleum industry, as the quantity of available refinery gas is immensely greater than the potential absorption in the chemical industry.

The processes of greatest importance to the oil industry are those such as polymerization which produce high-performance motor fuels. At present the most important process is alkylation, usually with *iso*butane and butylenes or other olefins. *iso*Butane, on account of its tertiary carbon atom, is the only hydrocarbon in refinery gas which will enter this reaction, which takes place in the presence of strong sulphuric acid. Supplies of the essential *iso*butane are limited, but, if necessary, may be immensely increased by the catalytic isomerization of normal butane.

*iso*Butylene is of particular importance to the petroleum industry, as it can, and is being catalytically polymerized to *iso*-octane, a high anti-knock gasoline, and to every petroleum product through lubricating oils to polymers of 400,000 mole. weight.

Reference should be made to the article for numerous other syntheses, both academic and commercial.

The article concludes with a brief discussion of the economic aspect of this utilization of refinery gases. T. C. G. T.

482.* Partial Volumetric Behaviour of the Lighter Paraffins in the Gaseous Phase. B. H. Sage and W. N. Lacey. *Refiner*, 1939, **18** (11), 466.—A method is proposed for the production of the specific volume of complex gaseous hydrocarbon mixtures. The procedure is summarized as follows:

(1) The analysis of the gas, which is expressed commonly as the mole. fraction of each of the components present, is modified to yield a corresponding quaternary analysis. (2) The latter is re-expressed in terms of weight fractions instead of mole. fractions. (3) The residual partial specific volumes of C_1, C_2, C_3, and n-C_4 paraffins for the prevailing pressure, temperature, and weight fraction of the component in question are interpolated from given tables. In general, simple linear interpolation with respect to pressure, temperature, and composition is adequate for the purpose.

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The value used for methane is taken as a weighted mean obtained for the binary systems involving methane with each of the other components of the modified analysis. (4) The average molal weight of the gas is computed from the original analysis. (5) The specific volume is calculated directly by substitution of the appropriate values in the derived equation. G. R. N.

483. Helium. A. W. Trusty. *Refiner*, 1939, **18** (8), 325.—A general and concise account of the occurrence and uses of helium. At the U.S. Government plant at Amarillo, Texas, natural gas at 600 lb. is washed with caustic soda solution to remove carbon dioxide. The gas is then cooled to — 300° F., which causes 95% to become liquid. The final stage is to subject the residue gas to a pressure of 2000 lb. and cool with liquid nitrogen. The finished helium is 98% pure. The present gross manufacturing cost is $8.20 per 1000 cu. ft. The estimated U.S. reserve of helium is given as 5928 million cu. ft. G. R. N.

484.* Standard Producer Gas Generator Design. Anon. *Fuel Econ.*, 1939, **15**, 336.—Attention is directed to the Parliamentry announcement that a design of producer-gas generating apparatus suitable for use with road-transport vehicles has been developed and that the design would be made available to firms able and willing to undertake manufacture.

The article is then continued with a summary of a lecture by K. W. Williams to the Junior Institution of Engineers, in which various types of producers are reviewed. T. C. G. T.

485.* New Developments in Burners. E. L. Dennis. *Refiner*, 1939, **18** (10), 419.—It has been established that higher heater capacity in heat input per hour, increased radiation from walls and floors, and optimum carbon-dioxide and water-vapour content in the combustion products are secured from the burner completing combustion most rapidly. Since the temperature of the gases will vary directly with the rate of combustion and indirectly with the mass occupied, the temperature of combustion will be higher with the least excess air for complete combustion. Incomplete combustion produces a reducing atmosphere in the heater, which results in serious impingement on the tubes. A "neutral" atmosphere is best assured by complete combustion—*i.e.*, the final products of carbon dioxide, water vapour, and nitrogen exist when the gases enter the tube banks and an excess air ratio of less than 10%. Burners fulfilling the above requirements are of the short-flame type—*e.g.* the pre-mix burner, in which the correct quantity of air is premixed with the gas fuel outside the heater by Venturi injection, proportioning, valves, etc., or the multi-jet designs, in which the combustion zone can be varied by changing the angle of the various jets, thorough mixing of the air and gas being completed by the turbulence in the heater. An individual type is the fan-mix burner, which mixes the gas with air essentially in the plane of rotation of a fan, which is propelled by the gas streams emitting from orifices in revolving arms mounted integral with the fan-blades. A 21-in.-diameter fan-mix burner has a capacity of 55 million B.Th.U. per hour with natural gas of 1000 B.Th.U. heating value. These burners show no visible flame in daylight, and there is no fan action in the heater, because the rapid expansion due to the high temperature of combustion kills the forward direction of the air-gas stream. Some of the advantages derived from the use of fan-mix burners in actual operation have been complete combustion with less than 5% of excess air in the flue gases, higher furnace temperatures on walls and floors, and in some cases as much as 40% increase in heat input without increased temperature of flue gases. There is also described a fan-mix type of burner designed on combined oil and gas firing, in which the oil-gun is inserted through the centre of the revolving shaft carrying the gas orifices. G. R. N.

Cracking.

486.* Measurement of Metal Temperatures of Cracking Still Tubes. O. G. Kaasa. *Nat. Petrol. News*, 15.11.39, **31** (46), R.478.—The square end of a length of No. 8 constantan wire is peened into a hole $\frac{1}{8}$ in. deep in the wall of the tube. The wire

is insulated with asbestos string and protected by a ½-in.-diam. calorized steel tube slipped over it and welded to the tube at one end. Outside the furnace wall No. 12 iron wire peened into the protector tube terminates with the constantan wire in a standard thermo-couple head connected to a switch panel. The device is claimed to have a useful life of about one year. H. G.

487.* Catalytic Cracking. A. L. Foster. *Refiner*, 1939, **18** (10), 412.—A review and analysis of future trends in this branch of cracking, which concludes as follows :—

(1) Catalytic cracking as now practised appears to be suitable economically for the larger-capacity installations in the larger refineries. The lowest unit capacity which is practicable has not yet been determined; but its size will be greatly reduced during the next two years, from those larger units now in successful operation.

(2) Catalytically cracked gasoline with a blending octane value of 90 or higher has a premium value of more than 1 cent per gall. or 47 cents per brl. as a conservative estimate from which the refiner can pay extra costs of operation. This premium valuation is based on octane-number improvement by saving in lead alone.

(3) Catalytic reforming or dehydrogenation of low-grade gasoline and naphtha appears to offer a means of fuel improvement and saving in refining costs, which is more immediately available to the average to small refinery at a comparatively low cost and long plant and catalyst life.

(4) Manufacture of special, extremely high-quality fuels has been made practicable for the refiner by the application of both thermal and catalytic processes.

(5) Catalytic desulphurization for improvement of octane number and for a remarkable increase in lead susceptibility has been perfected by two processes to a point where the average refiner handling high-sulphur products may apply it economically to his stocks. G. R. N.

488.* Petroleum-ization 1940. H. W. Field. *Refiner*, 1939, **18** (11), 450.—This A.P.I. paper gives a simple exposition of the processes of hydrogenation, dehydrogenation, polymerization, alkylation, desulphurization, isomerization, aromatization, cyclization, and catalytic cracking and reforming. In chart form and discussion, comparisons are presented to assist in locating in the refinery picture where these processes have application and which should be considered for various refinery situations. G. R. N.

489.* High Quality Aviation Fuel Base is Houdry Reforming Objective. A. G. Peterkin, J. R. Bates, and H. P. Broom. *Nat. Petrol. News*, 29.11.39, **31** (48), R.517–R.519.—Since the degree to which basic gasolines are improved by the addition of tetra-ethyl lead and blending stocks of high octane number varies considerably, the properties of those basic gasolines are of importance equal to that of the additives. Hence, in the Houdry process it is aimed catalytically to reform low-grade stocks to improve their susceptibility to additives. The catalyst is a highly activated hydrosilicate of alumina. H. G.

490.* Residuum Stripping. J. C. Allright. *Refiner*, 1939, **18** (9), 347.—At their Grandfield, Okla, refinery Bell Oil and Gas Co. have installed two vertical dry stripping columns in series. Residuum at 800° F. and 55 lb. pressure from the flash tower of the cracking unit is passed through these two columns, the pressure being reduced to approximately that of the atmosphere. The bulk of the vapours formed flash off in the second column and are condensed and cooled, giving a Diesel engine fuel. This product represents an additional 6% (on the cracking plant charge) of distillate yield from the cracking operation. G. R. N.

491.* Catalytic Polymerization of Butanes. F. B. Mack. *Refiner*, 1939, **18** (8), 330.—A description is given of the U.O.P. plant at the Shamrock refinery, Amarillo Texas, in which butanes from natural gas are thermally cracked to give pyrolytic polymer gasoline and unsaturates which are passed through a catalytic polymerization unit to give polymer gasoline. It is concluded that polymer production is useful in blending special gasolines as well as regular motor fuel. The desirable properties of

polymer products are : (1) high octane blending value, (2) low percentage of sulphur, (3) low gum content, (4) high inhibitor susceptibility, and (5) motor-fuel distillation range. The latter makes it possible to blend low-grade gasolines to higher fuel specifications. Tables of the characteristics of the polymer gasolines and their blends are given. G. R. N.

492.* Production of Fuels from Alto Udinese Shale. D. Costa. *Chim. e Ind.*, 1939, **22** (11), 609–612.—The author points out the desirability of employing the Resiutta shale oil to better advantage than its present use as liquid fuel oil. These oils, which range from 0·9379 to 0·9496 in specific gravity, give recoveries in the Engler distillation of 24% at 200° C., 29% between 200° and 300° C., and a residue. Refinery experiments on the distillates showed that, owing to the high content of unsaturated hydrocarbons and the high proportion (5·55% S) and nature of sulphur compounds in the crude oil, it was not possible to treat this oil by conventional methods for production of motor fuel. By hydrogenating cracking in a Bergius bomb at approximately 150 atm. pressure and maximum temperature of 390° C. using 4% MoS_3 catalyst, the author obtained a colourless product containing only 0·05% sulphur, and having a very low iodine number, from the fraction up to 260° C. P. G.

493. Patent on Cracking. K. Swartwood. U.S.P. 2,185,757, 2.1.40. Appl. 13.11.36.—Hydrocarbon distillates of low boiling characteristics and containing an appreciable quantity of fractions of low anti-knock value, boiling within the range of gasoline, are so treated as to produce gasoline of materially improved anti-knock value. The method consists in subjecting the distillates in a heating zone to cracking conditions, separating the resultant products into vaporous and non-vaporous components in a separating zone, and thereafter the vaporous components to fractional condensation. H. B. M.

Hydrogenation.

494.* Hydrogenation of Iraq Tar. A. Leopold. *Ann. Off. Combust. liq.*, 1939, **3**, 513–530.—The hydrogenation of two Iraq tars has been studied from the heat-of-reaction standpoint. Steel autoclaves were used at pressures varying from 110–258 ats. and 360–450°.

The composition of the steel was found to affect the amount of carbon produced during the hydrogenation considerably, a Ni–Cr steel producing more carbon than a Ni–Cr–Mo steel.

Using an aluminium silicate liner, two Iraq tars of almost identical composition were found to yield different proportions of the hydrogenation products, indicating that the elementary composition of a tar cannot serve as a basis for determining the best conditions for its hydrogenation.

Hydrogenation was found to begin at 360°. In order to reduce the amount of gas produced it was found necessary to vary the conditions of hydrogenation so that the heat absorbed during the endothermic zones was a minimum.

A comparison is drawn between results obtained using the above single-phase process and M. Vlugter's two-phase process, the results being very similar. W. S. S.

495.* Destructive Hydrogenation of Rumanian Residuum. C. Candea and L. Sauciuc. *Refiner*, 1939, **18** (10), 434.—The results of hydrogenation of residues from Bucsani crude oil indicate that (when operating in a stationary autoclave) only satisfactory saturation of unsaturated end products formed at 430° C. can be obtained when using catalysts and by the use of a sufficiently high hydrogen pressure. The hydrogenation takes place more smoothly at 440° C. at the same pressures and in the presence of a similar amount of catalyst, obtaining a much higher yield of gasoline. Operating at higher temperatures was not feasible, since the increased cracking reactions caused the pressures to rise above the maximum considered safe for the apparatus. Molybdenum trisulphide and the trioxide were the catalysts used. The former is a better cracking catalyst and gives higher benzine yields. The trioxide, having a greater hydrogenation action, gave excellent saturated gasolines, even though the yields were somewhat lower. G. R. N.

496.* Oil from Coal—An Intermediate Scale Plant. Anon. *Fuel Econ.*, 1939, **15**, 332–336.—A description of the semi-technical scale plant operated by the D.S.I.R. for the conversion of coal oil into motor spirit, etc.

The raw materials are raised to a temperature of about 300° C. by heat exchange with the products leaving the converter, and then pass to a gas-fired coil (the pre-heater), where the temperature is raised to 400° C. At this temperature the mixture enters the converter, where the ensuing reactions cause a further rise to the desired reaction temperature (usually 500° C.).

The raw materials consist of hydrogen and low-temperature tar from the Fuel Research Station's narrow brick retorts, to which is added a proportion of "recycle oil."

From a mixing-tank the tar and recycle oil are pumped at the required pressure, about 200 atmos., into a high-pressure pipe-line, where they are mixed with hydrogen at the same pressure and passed through the heat exchange and preheater to the converter.

The plant can operate at 200–400 atmos. pressure with a throughput of 200–400 gal. per day at 200 atmos.

The converter is a vertical cylinder of forged steel 15 ft. long and 16 in. internal diameter, with walls 3 in. thick.

The reaction chamber suspended concentrically within the converter is 11 ft. long and 8 in. internal diameter with walls of $\frac{1}{8}$ in. chrome-nickel steel. It is fitted with internal radial fins to assist the distribution of heat and of liquid raw material, and is filled with a granular catalyst consisting of molybdenum disulphide supported in alumina gel.

The products leaving the converter pass through the heat exchange and a water-cooled condenser to a high-pressure separator, where the residual gas is removed. The liquid products are then released into a low-pressure separator in which dissolved gas is evolved, whilst the oil passes to a still for the removal of the motor spirit by distillation.

The residual gas is about 90% hydrogen and the still residue is recycle oil.

T. C. G. T.

497.* Dehydrogenation, Polymerization, and Hydrogenation. A. V. Grosse, V. N. Ipatieff, G. Egloff, J. C. Morrell. *Nat. Petrol. News*, 29.11.39, **31** (48), R.520.–R.521.—Catalytic dehydrogenation is a new process developed to produce olefins from the gaseous paraffins, with the exception of methane. A mixture of *iso-* and normal butane, for instance, is passed over a catalyst at 1075° F. Hydrogen is removed from the resulting butenes and the latter are polymerized. The efficiency of the dehydrogenation process is 85–95% of the theoretical maximum, as compared with 15% in the thermal cracking process.

H. G.

Polymerization.

498.* Polymerization of Unsaturated Hydrocarbons. H. M. Stanley. *Chem. and Ind.*, 1939, **58**, 1080–1083.—The polymerization of unsaturated hydrocarbons is reviewed. Brief reference is made to the commercially developed processes—*e.g.*, for producing polymer gasoline—but the greater part of the article is devoted to the higher polymers, particularly those of styrene and methyl styrene.

Polymers from solutions of styrene in certain chlorinated solvents are considerably lower in mole. weight than those produced under comparable conditions in hydrocarbon solvents. This effect is particularly noticeable in carbon tetrachloride, in which a great reduction in polymer size takes place.

Peroxides and oxygen catalyse polymerization of styrene and reducing substances—*e.g.*, hydroquinone, pyrogallol, benzoquinone, hexamine and phenylnaphthylamine, inhibit the reaction. At elevated temperatures (80–150° C.) certain substances greatly diminish reaction velocity and increase the mean mole. weight of the resulting polymer; paraformaldehyde is one of the most potent agents of this class, which probably function by destroying the naturally occurring catalyst.

A further class of substance simultaneously reduces both the rate of polymerization and the polymer size. Phenylacetylene and hydroquinone are examples of this type which probably act by increasing chain breaking.

The author's work supports the belief that high mole. weight (60,000–120,000) polystyrenes contain one olefin bond.

α-methyl styrene can be readily polymerized by certain solid catalysts, *e.g.*, activated bleaching earths, to yield a whole range of polymers from colourless oily liquids to glass clear brittle solids of 3000–4000 mole. weight. T. C. G. T.

499. Patents on Polymerization. E. I. Du Pont de Nemours and Co. E.P. 516,931, 16.1.40. Appl. 13.7.38.—Process for polymerization of unsaturated organic compounds by bringing a diolefine or halogenated diolefine into contact with hydrated boron fluoride having from 1 to 2 mols. of water per mol. of BF_3. The polymerization is effected at a temperature of 0–30° C. and at a pressure not substantially greater than atmospheric.

H. I. Waterman. U.S.P. 2,188,273, 23.1.40. Appl. 22.7.36. An improvement in the manufacture of bodied oils by heating drying fatty oils to polymerizing temperatures in the presence of SO_2. A current of SO_2 gas is passed into and through the hot oil and the mixture agitated simultaneously to ensure intimate contact between the oil and the SO_2. The polymerization of the oil is in this way considerably accelerated. H. B. M.

Synthetic Products.

500.* Catalytic Hydrogen Peroxide Oxidation of Chain-Olefines. W. Treibs. *Brennst.-Chemie*, 1939, **20**, 358–360.—Tests were carried out in the homogeneous phase with a 30% H_2O_2–water solution, using acetone and methanol as solvents. Of the heavy metals tested only vanadium functioned satisfactorily as a catalyst, in the form of pervanadic acid. Under suitable conditions, 100 gm. chain-olefines were converted into oxygen-containing bodies within 30–40 hr.

An examination of the effect of catalytic attack by hydrogen peroxide on oxygen derivatives of paraffins revealed that primary alcohols and aldehydes are very stable; secondary alcohols are slowly oxidized to ketones; unsaturated alcohols easily add H_2O_2 to the double bond; paraffin ketones are much more stable than *cyclo*-ketones and chain-olefines; α-ketone alcohols are cracked to aldehydes and carbonic acids, especially in *statu nascendi*; α-glycols with a central glycol group are very stable, whilst those with a terminal glycol group are transformed on both hydroxyls.

In the primary process of H_2O_2 oxidation chain-olefines are hydroxylated. H_2O_2 is added either to the double bond leading to the formation of α-glycols, or it attacks the adjacent methylene groups and forms α, β-unsaturated alcohols. Further progress of the oxidation depends on the position of the double bond in the original olefine. If it is at the end, the primary products are unstable α-glycols which are oxidized; its α, β-unsaturated alcohols are slowly separated into oxalic acid and a monocarbonic acid. Olefines with the double bond in the centre form stable crystallized glycols which are ultimately converted into α-oxides.

It is concluded that, qualitatively, *cyclo*-olefines are attacked by H_2O_2 in a similar way to chain-olefines. In both cases H_2O_2 is added to the double bond, whilst adjacent methylene groups capable of reaction are hydroxylated. Quantitatively, the former reaction prevails with chain-olefines, the latter with *cyclo*-olefines. L. R.

501. Production of Lubricating Oils by CO–H_2 Synthesis. H. Koch. *Archiv. f. Eisenhüttenwesen*, 1939, 533–535.—The development of synthetic petrol production in Germany is shown as compared with the rest of the world. For synthetic production of lubricating oils the Fischer–Tropsch and the I.G. processes are available. New details are given, and it is stated that the lubricating value of the oils depends largely on the molecular structure of the materials treated. E. W. S.

502. Patents on Synthetic Products. N.V. de Bataafsche Petroleum Maatschappij. E.P. 516,659, 8.1.40. Appl. 4.8.38. Manufacture of *iso*butane from normal butane by contacting normal butane, preferably in the gaseous phase at temperatures below 200° C., with a catalyst. The catalyst consists of aluminium chloride mixed with or brought on to a carrier substance comprising an inorganic substance containing water which normally can only be split off at temperatures above 200° C.

E. I. Du Pont de Nemours and Co. E.P. 516,688, 9.1.40. Appl. 4.7.38. Manufacture of vinylacetylene by polymerization of acetylene in the presence of a liquid mass of catalyst, the latter consisting of water, saturated or nearly saturated with a mixture of ammonium chloride and cuprous chloride.

Deutsche Hydrierwerke A.-G. E.P. 516,879, 15.1.40. Appl. 11.7.38. Capillary active substances are manufactured by condensing organic hydroxyl compounds with aliphatic halogen-ketones containing at least one exchangeable halogen atom, reducing the ketone group of the condensation compound to a secondary alcohol group and thereafter converting the latter into a water-solubilizing group by sulphonation or treatment with alkylene oxides.

Deutsche Hydrierwerke A.-G. E.P. 516,978, 17.1.40. Appl. 13.7.38. Method of manufacturing capillary active products whereby one or more aliphatic, *cyclo*aliphatic, or hydro-aromatic hydroxyl compound having a lipophile group is reacted with one or more halogen ketone having an easily exchangeable halogen atom. The ketone group of the reaction product is thereafter reduced to give a secondary alcohol group, and the secondary alcohol group then converted into a water-solubilizing group.

H. B. M.

Refining and Refinery Plant.

503.* Thermosyphon Treating Plants. D. H. Stormont. *Oil Gas J.*, 21.12.39, **38** (32), 37.—Tests have been carried out to determine the reasons for the low crude capacity of an emulsion-treating gun barrel heated by thermosyphon circulation from an external heater. It was found that the 4-in. swing check-valve installed to guard against back flow required an 0·8-in. head of water to lift it from its seat, the whole head available in the thermosyphon system being only 0·95 in. The long flow-lines in the average system also constitute a bottle-neck. Increasing the heat input into the heater is inadvisable, as the water should not be heated to more than 160° F. to limit precipitation. The thermosyphon automatic method of circulation is preferred to the flow-line method owing to the absence of fire risk and danger of overheating the oil, and to the effect of the wash water in reducing corrosion troubles. To be effective the following factors should be taken into consideration : (1) Circulating lines should be at least 6 in. diameter and as short as possible. (2) No trap should be allowed in the return piping from the heater to the gun-barrel. (3) The return circulating line should be insulated and the feeder circulating line insulated or buried. (4) No check-valve should be installed anywhere. (5) The return circulating line should enter the gun-barrel as high as possible, but below the wash water–oil interface level. (6) The temperature of the water in the heater should not exceed 160°. (7) The gun barrel should either be insulated or a wood tank used. C. L. G.

504.* Catalytic Desulphurization to Improve Aviation Blending Naphthas. W. A. Schulze and R. C. Alden. *Oil Gas J.*, 17.11.39, **38** (27), 199.—It has been shown that various sulphur compounds have a pronounced effect on the lead response of gasoline. Monosulphides, disulphides, and cyclic sulphur compounds present in refined gasolines show this deleterious effect, which is greatest at low concentrations. Complete removal of these sulphur compounds from gasoline can be effected by contacting the hydrocarbon vapours with bauxite catalyst at 700–750° F. Examples of the effect of desulphurization of natural gasoline fractions and straight-run gasoline are given. These show that removal of the sulphur compounds from low-sulphur-base material has a considerable effect on lead susceptibility. This improvement is particularly valuable in the case of gasoline used as a component of high-octane aviation fuel. Commercial *iso*-octane and *iso*-pentane used as blending agents are practically free from sulphur, so that any improvement of aviation blends by desulphurization can only be effected by treatment of the base-stock. Examples of the saving in the amount of commercial *iso*-octane in aviation blends by desulphurizing the blending naphtha are given. R. J. E.

505.* Maintaining Decolorizing Clays at High Efficiencies. T. P. Simpson and J. W. Payne. *Oil Gas J.*, 17.11.39, **38** (27), 147.—The regeneration of spent clay used in mineral oil refining is carried out by burning in a multiple-hearth kiln, which in recent

years has displaced the rotary kiln. This type of kiln suffers from inherent disadvantages attributable to poor temperature control. The development of a kiln named "thermofor kiln," which embodies control of temperature burning rate, and heat transfer is described. In this kiln the clay is heated at 900–1200° F. The following comparative advantages are claimed for this kiln: (1) Reactivation of clay to higher efficiency. (2) Low construction and operating costs. (3) Excellent regeneration by partial combustion or carbonization. (4) Economical on small scale. (5) Ease of operation and reduced fire hazard. Detailed descriptions of the design and operation of the "thermofor kiln" are accompanied by illustrations.

R. J. E.

506.* Regeneration Step in the Solutizer Process. D. L. Yabroff, E. R. White, and A. V. Caselli. *Refiner*, 1939, **18** (11), 509.—The solutizer process achieves complete sweetening of sour gasolines by extracting them with caustic solutions that contain a suitable organic solvent or salt—*e.g.*, sodium *iso*butyrate, which acts as a solubility promoter—*i.e.*, a solutizer. The spent solutized caustic solution is regenerated by stripping with steam, and can be used indefinitely to sweeten further quantities of gasoline. Values of K_p, the stripping constant, are presented for the various pure mercaptans, and the calculations are shown for the steam requirements in the regeneration step. These are of value in helping to establish the optimum design and operating conditions of a given solutizer plant. G. R. N.

507.* Thermofor Kiln for Clay Regeneration. T. P. Simpson and J. W. Payne. *Refiner*, 1939, **18** (11), 438.—The kiln consists of a stationary chamber containing vertical heat transfer tubes through which the heat transfer medium flows. This medium, which is molten metal or salt, has a temperature of 850–1150° F. and is designed to add heat to or withdraw heat from the clay as required. Angle irons are stacked between the tubes to form a honeycomb of steel, serving as the necessary burning hearth surface, securing uniform flow of clay through the kiln, making air passages, and aiding heat transfer. A commercial unit with burning capacity of 50 tons clay per day has been operating on clays used for percolating Penna stocks. Some batches of clay have been burned sixteen times with maintenance of their efficiency at 100%. No outside fuel is required for the kiln, the necessary heat being furnished by the burning of the carbonaceous material adsorbed in the clay. Controlled partial oxidation produces an active carbon in the pores of the clay, and this has a good adsorptive power for certain colour substances. Clays that have been "partially oxidized" show from two to four times the efficiency of those from which the carbon has been burned completely in percolating stocks treated by the Duo Sol or other solvent extraction processes. The Thermofor kiln is conservatively estimated to pay out both investment and paid-up royalty in one or two years. G. R. N.

508.* Sulphuric Acid for Algæ Control in Cooling Water. R. D. Koons. *Refiner*, 1939, **18** (10), 397.—At the Norwalk refinery of the Wilshire Oil Co. the cooling water system consists of an 800-ft. cooling tower with a 400,000-gal. cement reservoir below, and closed and open-box condensers. The make-up water is obtained from a 100,000-brl. open, cement-lined pond. The algæ growth occurs on the top decks of the tower, and to remove it commercial sulphuric acid is siphoned into the reservoir at the rate of from one to three 12-gal. glass carboys per 8-hr. shift. The acid must travel 800 ft. along the cement reservoir before it comes in contact with metal, and there has been no corrosive action. No normal carbonates exist in the water if the *p*H is below 7·9–8·1. When the refinery was shut down the closed condensers on inspection showed no slime growth, scale deposits or corrosion. The reduction in maintenance costs alone was 1·8 times the cost of the acid. There were also the gains of better heat transfer and reduced pumping costs. G. R. N.

509. Petroleum Emulsions and their Treatment. Summary of Operations. *California Oil Fields*, 1937 (1939), **23** (2), 5.—Of the two kinds of emulsions, oil-in-water and water-in-oil, the latter is the most frequent occurrence in oil production, and is considered in this paper. Such emulsion consists of finely divided water particles dispersed within the oil mass, each water particle being encased in an

elastic film; this mixture is usually referred to as "cut oil." The emulsions are classified as "tight" and "stable" or "loose" and "unstable," the essential difference being that "tight" emulsions are formed in the presence of emulsifying agents such as silica, rotary mud, asphalt, etc. Such agents are in colloidal suspension at the interface of the emulsion particle. The amount of water in emulsified oil depends on a number of factors, chief of which are the nature of the base, the emulsifying agent, temperature, and degree of agitation to which the emulsion is subjected. Oil-wells producing large amounts of water generally have smaller emulsion cuts than those with less water.

Emulsification is preventable in many cases by eliminating primary causes, as, for instance, by reducing agitation, producing chemical conditions inhibiting emulsification, and separating water prior to formation of emulsion. Of these the most important is agitation, and its reduction can be attempted by decrease in pumping speed, maintaining pump submergence, use of gas anchors, elimination of tubing leaks, care and maintenance of bottom-hole and surface transfer pumps, and avoidance of lead-line turbulence by preventing obstructions, restrictions or bends in the lead lines. To combat the difficulty of "cut oil" apart from the foregoing precautions, various methods of treatment are employed; these depend on the type of oil involved, its gravity, viscosity, asphaltic content, or carbon residue, and size of dispersed water particles; viscosity is regarded as being specially important, a high value being a retarding factor in breaking down the emulsion. "Tight" emulsions are hard to break down, and necessitate special treatment; "loose" or unstable emulsions may be more easily broken by heat or may separate on standing.

The commonest methods of treatment include rolling oil in tanks with gas or steam, heating in tanks or heating large amounts of oil and free water. Heat-treating plants depend on the combined action of heat and water scrubbing, sometimes in conjunction with a chemical, on clean "cut oil." Another method is that of electrical dehydration, which has become increasingly popular with expanding power supply to most producing fields. Chemical dehydration has been in use for many years, and many compounds have been evolved which depend for their efficiency on the characteristics of the oil in each case. It is claimed for chemical dehydration that when carried out at flow-line temperature both installation and upkeep costs are low, no expensive equipment being necessary. In all cases, however, laboratory tests of the emulsified oil are essential to a proper understanding of the nature of the emulsion and of the most efficient means of treating it as a factor in refining process. H. B. M.

510. Petroleum Refineries, including Cracking Plants, in the United States. G. R. Hopkins and E. W. Cochrane. U.S. Bureau of Mines, Information Circular No. 7091, October 1939.—The Bureau of Mines' annual survey of refinery capacity in the United States showed that during 1938 there were fewer plants in existence than in previous years. Several new units were completed, but far more were closed down. Nevertheless, the total capacity to produce crude oil materially increased. On 1st January, 1938, the total completed capacity was estimated at 4,351,151 brl., whilst on 1st January, 1939, it had risen to 4,508,555 brl. During the period under review, however, the number of inactive plants increased by approximately 50%, thus reflecting the comparative slump in the refining industry since the prosperous year of 1937.

As far as cracked gasoline plants were concerned, total capacity continued to be increased during 1938, but the slump was again reflected in the decline in newly constructed units. On 1st January, 1938, these totalled 86,060 brl. per day, whilst on 1st January, 1939, the number had decreased to 47,180 brl. Moreover, in 1938 there was an increase of approximately 40,000 brl. in idle capacity as compared with 1937. The daily average output of cracked gasoline in 1938 was 741,000 brl., representing an operating ratio of 86% for active plants or 77% for both active and inactive equipment. H. B. M.

511.* High-Octane Aviation Gasoline by Sulphuric Acid Alkylation. (A Condensation of "High-Octane Aviation Fuel by the Sulphuric Acid Alkylation Process." S. H. McAllister. 20th Annual Meeting of the A.P.I., Chicago, 17.11.39.) *Nat. Petrol. News*, 29.11.39, **31** (48), R.512–R.516.—The process affects the direct union of olefins and *iso*paraffins, in approximately equal volumes, to produce branched-chain paraffins.

In continuous plants the olefins are diluted with *iso*paraffins and passed, at ordinary temperature, into an emulsion of concentrated H_2SO_4 and *iso*paraffin. The presence of the excess *iso*paraffin effectively controls the extent of olefin absorption. *iso*-Butane is the most widely used *iso*paraffin. The olefins usually receive a light caustic wash to reduce the content of mercaptans, etc., the presence of which cause too rapid reduction in the activity of the acid. H. G.

512.* Thermal Alkylation to Produce Auto and Airplane Fuels. G. G. Oberfell and F. E. Frey. *Nat. Petrol. News*, 29.11.39, **31** (48), R.502.—The alkylation reaction can be conducted either catalytically or thermally to produce *iso*paraffinic fuels of high octane number. In the two-stage process, mixed ethane, propane, and butane may be cracked in one stage to produce olefins from the lighter part of the stock, the olefins being reacted with the heavier part of the stock in the second or alkylation stage.

Neohexane is produced by the thermal alkylation at high pressure of ethylene and *iso*butane. Neohexane is an *iso*paraffin of high octane number and is suitable for use as an aviation fuel. Its volatility is higher than that of *iso*-octane and its lead susceptibility is high. A commercial plant for its production is in course of development. H. G.

513.* Modern Automatic Control Apparatus for Topping, Cracking, and Polymerization Plants. D. J. Bergman. *Oel u. Kohle*, 1939, **35**, 675–678.—Maximum uniformity in plant operation necessitates adequate self-recording and adjusting instruments; these are considered in relation to a crude-oil topping plant, a Dubbs cracking plant, and a U.O.P. contact polymerization plant. Thus, *e.g.*, an influx regulator in the oil-feed line provides for a uniform charge to the pipe-still, and an automatic temperature recorder in the furnace egress ensures uniformity throughout the plant. Simplified self-explanatory flow-sheets are given, showing the location of the automatic control apparatus. A. V. B.

514.* Combination Unit at the Government Refinery of La Plata. B. Rikles. *Bol. Inform. Petroleras*, November 1939, XVI (183), 43–46.—This is a short description of a new combination unit for primary distillation, cracking of heavy fuel oil and light gas oil, and for production of petrol by vaporization and polymerization of the gas. The plant is capable of dealing with 1500 $m.^3$ of crude oil per diem. H. I. L.

515. Patents on Refining and Refinery Plant. J. A. Buchel and R. N. J. Saal. U.S.P. 2,185,291, 2.1.40. Appl. 19.1.38. Separation of hydrocarbon oils into portions of different degrees of paraffinicity by bringing the oil into contact with a selective solvent for non-paraffinic hydrocarbons in the presence of chloroform, under conditions causing the formation of liquid extract and raffinate phases and thereafter separating the phases.

T. L. McGee. U.S.P. 2,185,380, 2.1.40. Appl. 4.10.37. Process for preventing corrosive action of sulphur-bearing petroleum hydrocarbons on metal of the apparatus in which they are being treated. Finely divided iron dispersed in a carrier oil of relatively low sulphur content is continuously injected into the hydrocarbons once they have attained an initial critical corrosive temperature. The iron dispersed in oil is previously heated to approximately 150° F. in excess of the said corrosive temperature.

D. F. Gould. U.S.P. 2,185,406, 2.1.40. Appl. 2.8.37. Method of refining a hydrocarbon oil from the group consisting of benzol, toluol, xylol, or mixtures thereof, solvent naphtha and drip oil, by the addition of sulphuric acid to the oil. The mixture is heated in the liquid phase, and subsequently the oil is distilled off and the acidic constituents of the resultant distillate are neutralized.

R. S. McKinney. U.S.P. 2,185,414, 2.1.40. Appl. 29.3.38. The drying properties of oils are increased by heating at a temperature of 200–250° C. for 2–18 hr. with about 0·1% of an alkaline hydroxide.

T. P. Simpson, J. W. Payne, J. A. Crowley, Jr., and C. S. Teitsworth. U.S.P. 2,185,930, 2.1.40. Appl. 1.9.37. Hydrocarbons are converted into the gasoline type by passing them in vapour phase through a body of contact material at a temperature range in which substantial conversion of the hydrocarbons will take place. The passage of the hydrocarbons through the contact material continues until the deposit on the contact material renders it inefficient. Thereafter it is regenerated *in situ* by blowing combustion-supporting gas through the body of the material in thin streams.

T. P. Simpson, J. W. Payne, J. A. Crowley, Jr., and C. S. Teitsworth. U.S.P. 2,185,931, 2.1.40. Appl. 1.9.37. Apparatus for effecting catalytic conversion of hydrocarbons and concurrent regeneration of the catalytic material *in situ* in another zone of the same apparatus.

F. Rositer and V. Mehuer. U.S.P. 2,185,952, 2.1.40. Appl. 21.7.38. New and valuable unsaturated hydrocarbons are produced by mixing acid sludge from the sulphuric-acid refining of petroleum oils with an inorganic alkaline reagent. The reagent is employed in a quantity in excess of that required to combine with all the sulphur present in the sludge.

N. E. Lemmon. U.S.P. 2,187,883, 23.1.40. Appl. 30.12.37. Method of refining viscous hydrocarbon oil by treating with sulphuric acid. Thereafter it is neutralized with caustic soda and finally heated to a temperature of approximately 350–550° F. in the presence of ammonia while agitating with an inert fluid.

Trinidad Leaseholds, Ltd., and Emil Hena. E.P. 516,019, 20.12.39. Appl. 18.6.38. Treating mineral oil distillates with acid, and particularly the more volatile distillates with sulphuric acid. After the addition of the acid the mixture is allowed to settle for about 5 min. Thereafter a small amount of finely divided adsorptive material is added to promote separation of sludge-forming bodies.

Société Générale de Fours Coke Systêmes Lecocq. E.P. 516,125, 22.12.39. Appl. 20.6.38. Continuous distillation and rectification of liquids by means of rotary distillation chambers in which the distilled vapours are conducted in counter current to the liquid to be distilled. Distillation carried out in a horizontal rotary drum having spaces for the passage of liquid and vapours which reach the condenser by passing through a conduit in the shaft of the rotary drum.

E. I. Du Pont de Nemours and Co. E.P. 516,587, 5.1.40. Appl. 29.6.38. Process for the thermal decomposition of hydrocarbons by means of partial oxidation to produce valuable hydrocarbon degradation products. A hydrocarbon is introduced into a rapidly moving stream of oxidizing gas, preheated to a temperature not lower than the ignition temperature of the hydrocarbon at two or more successive points relatively close together.

A. Schlegel. E.P. 516,831, 12.1.40. Appl. 11.7.38. Oil is refined or cleaned by boiling under vacuum and filtering, an adsorption or refining medium being mixed with the oil before boiling to expedite the operation. If insufficient water is present in the oil, a small quantity is added with the adsorption medium.

A. S. Lee and the Superheater Co., Ltd. E.P. 516,866, 15.1.40. Appl. 7.7.38. Improved method of cooling and washing oil by effecting intimate contact between it and water, and thereafter separating the oil from the water. The water and oil are admitted separately and continuously into a common vessel and passed through each other in the form of fine streams under an appropriate head or pressure.

H. B. M.

Safety Precautions.

516.* Boiler House Precautions When the Siren Goes. Anon. *Fuel Econ.*, 1939, **15**, 337–338.—It is assumed that the steam demand in a works during an air raid would cease, but that immediate dispersal of the steam pressure is not permissible, as the clouds of steam would form an attraction to enemy aircraft.

It is therefore recommended that the following minimum precautions should be taken before the firemen take cover :—

(1) Close dampers.
(2) Stop mechanical stokers.
(3) Draw fires or damp them down with ashes or similar inert material.
(4) See that there is plenty of water showing in the gauge glasses (suggested about three-quarters full).
(5) Adjust feed-pump and feed-check valve on the boiler to deliver water at the normal rate of evaporation.
(6) See that the blow-down valve is closed. (On no account should the valve be opened.)
(7) Open an escape-valve on the boiler to allow of a moderate discharge of steam to atmosphere. T. C. G. T.

Chemistry and Physics of Petroleum.

517. Sulphonation Reactions with Sulphuryl Chloride. M. S. Kharasch and A. T. Read. *J. Amer. chem. Soc.*, 1939, **61**, 3089–3092.—The free-radical mechanism accounting for the chlorination of various types of organic molecules by sulphuryl chloride (*J. Amer. chem. Soc.*, 1939, **61**, 2142–50; *J. Inst. Petr.*, 1940, **26**, Abstr. No. 308) should also apply for simultaneous sulphonation. This was found to be the case although peroxides did not exert the beneficial effect on the sulphonation that they showed towards the chlorination, and such compounds as were found to catalyse the sulphonation did so only in the light. The most effective of these were the aromatic nitrogen ring compounds, the pyridines and quinolines. The reaction was quite general for aliphatic hydrocarbons, and when applied to an aromatic compound with an aliphatic side-chain the sulphuryl chloride always attacked the molecule at the side-chain, indicating, as before, a free-radical mechanism. R. D. S.

518. The Peroxide Effect in the Addition of Reagents to Unsaturated Compounds. XXIII. The Reaction of Styrene with Bisulphite. M. S. Kharasch, R. T. E. Schenck, and F. R. Mayo. *J. Amer. chem. Soc.*, 1939, **61**, 3092–3098.—This work confirms the formation of benzoic acid, 2-phenylethanesulphonic acid, and 2-phenylethylenesulphonic acid in the oxygen- or nitrite-catalysed reaction between ammonium bisulphite and styrene, but shows also that 2-hydroxy-2-phenylethanesulphonic acid is formed to a greater extent than the other products. The substitution of bisulphite in styrene is explained by a mechanism which functions in the presence of oxygen, and the formation of the hydroxy-compound is based on a mechanism of a different type, not depending on the nature of the oxidant. R. D. S.

519.* Relative Effect of Inhibitants on Adsorption and on Catalytic Activity. Part II. E. B. Maxted and H. C. Evans. *J. chem. Soc.*, 1939, 1750–1754.—The velocity of adsorption of hydrogen by platinum is retarded in a similar way to the inhibition of the velocity of hydrogenation catalysed by platinum, so that it may be considered as a special case of the latter in which the catalyst is the ultimate acceptor of the hydrogen. This similarity is emphasized in this paper, which describes how the effect of a poison on the catalyst is comparable throughout the poisoning graphs of both phenomena. R. D. S.

520.* Liquid-Phase Reactions at High Pressures. Part V. The Polymerization of *cyclo*Pentadiene and α-Di*cyclo*pentadiene. B. Raistrick, R. H. Sapiro, and D. M. Newitt. *J. chem. Soc.*, 1939, 1761–1769.—This paper deals with the liquid-phase polymerization of *cyclo*pentadiene at pressures up to 5000 atm. over a temperature range of 0–40° C. According to conditions of temperature and pressure, *cyclo*pentadiene undergoes polymerization in three distinct stages : (1) dimerization, where the products are α-di*cyclo*pentadiene and unchanged monomer only ; (2) association to higher polymers, amongst which the trimer and tetramer have been identified, and (3) an explosive decomposition reaction producing gas and a highly carbonized residue. Stage (3) is discussed in the following paper, but the first two are considered here

with reference also to the dissociation and polymerization of α-di*cyclo*pentadiene which was carried out at 138°. The latter polymerizes after first dissociating into *cyclo*pentadiene, the polymers being of the same type as formed in stage (2) above. The kinetics of the dimerization reaction are given. R. D. S.

521.* Liquid-Phase Reactions at High Pressures. Part VI. The Explosive Decomposition of *cyclo*Pentadiene. B. Raistrick, R. H. Sapiro, and D. M. Newitt. *J. chem. Soc.*, 1939, 1770–1773.—An investigation into the carbonization of *cyclo*pentadiene (Stage (3) observed in the above paper) is reported in this communication, with the results of the study of the effects of temperature, diameter, and nature of the material of the reaction tube and pressure of a diluent on the carbonization pressure. The critical carbonization pressure increased with decreasing diameter of the reaction tube at 20° and 30°, and this effect was also brought about by increasing dilution with polar and non-polar solvents. The material of the tube also affected the critical pressure. The gas formed in the reaction was chiefly methane. Ultimate analyses are given on the carbonaceous material and the semi-transparent shell round it. All these results are considered with regard to the mechanism of the reaction.
R. D. S.

522.* A.P.I. Hydrocarbon Research Project. D. P. Barnard. *Oil Gas J.*, 17.11.39, **38** (27), 117.—This project was undertaken to provide basic data on the combustion characteristics and the physical and thermal properties of gasoline hydrocarbons. The organization and administration of the project are outlined. As many hydrocarbons in the gasoline-volatility range as experience shows to be practical and possible will be examined; the scope is likely to be limited to those falling within the C_5 to C_{12} range inclusive. So far three procedures have been adopted for the preparation of hydrocarbons :—

(1) Synthesis of tertiary carbinols from ketones or esters with Grignard reagent and dehydration to produce olefines. The olefines may, if desired, be hydrogenated to give saturated hydrocarbons.
(2) Synthesis of olefines from alkyl unsaturated halides by the Grignard reaction. The olefines may be hydrogenated to give the corresponding paraffins.
(3) Direct hydrogenation of aromatics to give the corresponding *cyclo*hexane derivatives.

The procedure adopted and the apparatus used for the purification of the hydrocarbons prepared are described in detail.

The engine-testing procedure programmed consists in determining the critical compression ratio of the hydrocarbon over a wide severity range, which includes conditions which are milder than those of the C.F.R. Research method and conditions which are more severe than those encountered in aircraft practice.

Whilst no set programme for the determination of physical and thermal properties has been arranged, the hydrocarbons prepared will be made available to workers who specialize in the testing involved, so that full advantage will be taken of the availability of pure hydrocarbons. Specialized workers who are interested are invited to approach the Committee with a view to co-operating in this aspect of the project.
R. J. E.

523.* Pyrolytic Alkylation of Hydrocarbons. R. Fussteig. *Petrol. Engr*, November 1939, **11** (2), 45.—A discussion is presented of investigation work on the pyrolytic alkylation of hydrocarbons, and of the reactions occurring under different conditions and with different catalysts. In the presence of H_2SO_4 alkylation of aromatic hydrocarbons with ethylene requires a pressure of 58 atm. With butylene the higher the concentration of the acid, the more complete the alkylation and the higher the boiling range of the product. Thus 90–96% acid produces alkylation, 80% acid polymerization, and 20% only the ester. Catalysts giving simpler and more complete alkylation include phosphoric acid, phosphoric pentoxide, and 85–90% *ortho*phosphoric acid, aluminium chloride, boron fluoride, zirconium chloride, and nickel oxide-alumina. In general, the higher the molecular structure of the olefin, the smaller its tendency to alkylation and the stronger its polymerization power. Alkylation is generally accompanied by secondary reactions such as condensation and cyclization, higher

pressure tending to simplify the reaction. Boron fluoride is a stronger and more selective catalyst in the alkylation of cyclic compounds, reacting only with carbon atoms having tertiary bonds. With *iso*paraffinic hydrocarbons aluminium chloride may result in undesirable reactions, since normal paraffins also react—viz., alkylation, isomerization, polymerization, and catalytic cracking; this process is termed auto-destructive alkylation, as the olefins formed take part in a further alkylation reaction. Similar alkylation takes place with the aromatic hydrocarbons. It is suggested that controlled alkylation will be used to produce high-quality lubricating oils and paraffin waxes in addition to high-octane-rating gasoline and special *iso*paraffins. C. L. G.

524.* Chemical Composition of Synthetic Gasolines. A. N. Sachenen. *Refiner*, 1939, **18** (12), 521.—Gasolines from mixed-phase cracking at medium pressures contain 30–40% unsaturates distributed in decreasing proportion with increase in b. pt. of the fractions. The paraffin content decreases, whilst the aromatic content increases, with the boiling range. The composition of these gasolines is greatly influenced by the crude sources and the cracking conditions. Vapour-phase cracked gasoline contains more unsaturates and more aromatics than the mixed-phase product. Houdry gasoline is rich in paraffins and comparatively poor in unsaturates and aromatics; the paraffins are of the highly branched type. Hydro-gasolines contain about 1–2% unsaturates. Their aromatic content depends on the reaction temperature and is high when this is above 500° C. Catalytic polymer gasolines contain more than 50% unsaturates, whereas thermal polymer gasolines contain around 35%. A short discussion of the phenolic and sulphur compounds present in synthetic gasolines is also given. G. R. N.

525.* Density and Viscosity of Glycerol Solution at Low Temperatures. E. Green and J. P. Parke. *J. Soc. chem. Ind.*, 1939, **58**, 319–320.—Densities and viscosities of aqueous glycerol solutions containing 30–80% of glycerol have been determined at temperatures between $-5°$ C. and $-40°$ C.

The viscosities were found to be higher than the published figures, notably those of Herz and Wegner. T. C. G. T.

526.* Induced Pyrolysis of Methane. W. J. Hessels, D. W. van Krevelen, and H. I. Waterman. *J. Soc. chem. Ind.*, 1939, **58**, 323–327.—The pyrolysis of methane is promoted by the addition of foreign substances—in fact, radicals formed by the pyrolysis of methane react with each other and with undecomposed methane. Examples of foreign substances that act as inductors are halogens, aliphatic hydrocarbons, and hydrocarbon derivatives, such as halogen, sulphur, or oxygen compounds, and a series of these have been investigated. Aromatic hydrocarbons were found to have no inductor effect.

At 1170° C. with a contact time of 0·06 sec.—conditions under which methane, in the absence of inductors, is unaffected—various examples of inductors mentioned above have been demonstrated to promote the formation of ethylene, acetylene, benzene, and naphthalene.

In all the experiments a remarkable dilution effect has been observed. The greater is the excess of the methane compared with the quantity of the inductor, the more methane is involved in the reaction by an equal quantity of inductor.

Induced pyrolysis may be applied to methane in natural gases. These gases normally contain compounds capable of acting as inductors. T. C. G. T.

527.* Stoichiometric Calculations of Exhaust Gas. G. W. Gleeson and F. W. Woodfield, Jr. *Nat. Petrol. News*, 1.11.39, **31** (44), R.461–R.464.—In the calculation of the composition of the exhaust gases from internal-combustion engines reasonable accuracy is achieved by using the equilibrium constants of the water-gas reaction,

$$\text{K.w.g.} = \frac{(H_2O)\ (CO)}{(H_2)\ (CO_2)}$$

The composition of the fuel must be known. Since the calculations are not specific to any particular type of engine, appreciable discrepancies between experimental and theoretical values may indicate mechanical or operational deficiencies. H. G.

528.* Preparation of Some Pure Hydrocarbons. Parts I and II. H. I. Waterman, J. J. Leendertse, D. W. van Krevelen, and J. F. Sirks. *J. Inst. Petrol.*, 1939, **25**, 801–812.—A description is given of the preparation and properties of octylbenzene, octyl*cyclo*hexane, hexadecane, octadecylbenzene, octadecyl*cyclo*hexane, and hexatriacontane. G. R. N.

529. Patent on Chemistry and Physics of Petroleum. George William Johnson. E.P. 516,160, 22.12.39. Appl. 7.6.39.—Conversion of carbon monoxide with hydrogen into hydrocarbons with more than one carbon atom in the molecule in the gaseous phase in the presence of catalysts. This comprises passing over the catalyst vapours of organic liquids in which the conversion products of high molecular weight deposited on the catalyst are soluble, under such conditions that at least a partial condensation of the vapour occurs, thereby regenerating the catalyst by extracting the said products. H. B. M.

Analysis and Testing.

530.* Significance of Viscosity in the Use of Petroleum Oils. W. L. Nelson. *Oil Gas J.*, 23.11.39, **38** (28), 46.—The viscosity of petroleum products is of obvious practical significance in connection with pressure drop in pipe-systems, heat-exchangers, pipe-lines, etc., and with flow through filtering equipment and wicks of lamps. For fuels in steam atomizing burners the viscosity should be 150 secs. S.U. at the firing temperature. It is suggested that grading of fuel oils according to viscosity is a more reasonable basis of price than their gravities. For automotive oils viscosity is related to (1) pumpability, (2) power consumption, and (3) surface lubrication. (1) Pumpability determines the amount of oil circulated and the lowest starting temperature. A table for the rate of flow of motor oils at crank-case temperatures of 160° F. and 70° F. indicates that oil circulation is not greatly dependent on viscosity at high crank-case temperatures, but at low starting speeds or temperatures the heavier oils do not circulate freely. The time after starting for oils of different viscosities to appear above the pistons has been measured, and been found very high for heavy oils (above 30 min.). For starting the engine the viscosity of the oil should not exceed 40,000 secs. S.U. at the starting temperature. (2) Frictional resistance is best measured by gasoline consumption, the higher consumption of lubricating oils of low viscosity being more than offset by the saving in gasoline. (3) From the point of view of engine wear it has been shown that even the lightest grades of automotive oils (S.A.E. 10 W and 20 W) provide adequate lubrication. Even S.A.E. 30 oils diluted with 75–90% kerosine did not cause excessive wear. In many cases faulty lubrication has been traced to the lack of oil rather than to its low viscosity. C. L. G.

531.* Carbon Residue Test Not Closely Related to Performance. W. L. Nelson. *Oil Gas J.*, 11.1.40, **38** (35), 48.—The carbon-residue test provides a good indication of the amount of carbonaceous residue deposited from gas-oils in gas-enrichment chambers, owing to the similarity between the conditions of the test and actual practice. It is also related to the quantity of deposits on burner nozzles or other heated surfaces from fuel oils, but this is affected by so many other factors that no great significance can be attached to the test.

No definite relationship exists between carbon residue content of lubricating oils and carbon deposits in I.C. engines, although a fair agreement has been found in the use of oils from a single base of crude oil. Carbon formation in engines depends on (1) Volatility of the oil at engine conditions; (2) stability to heat and oxidation; (3) type of carbon deposit produced, and (4) mechanical factors. The varied nature of these factors, as well as the effect of *e.g.* gum in the fuel or dust in the air, renders the formulation of a single test very difficult. (1) Volatility is of importance since an oil of high boiling range will remain on the combustion-chamber walls for a long time, and is thus more subject to decomposition by heat than a more volatile oil. It has been suggested that the 90% boiling point under 1 mm. pressure is related to carbon formation, and also that the loose, fluffy nature of deposits from naphthenic base oils is due to their comparatively low boiling range, so that decomposition takes place in the vapour phase rather than the liquid. (2) It is shown that there is no

relationship between the carbon residues of used oils and the amount of engine carbon. Asphaltenes, carbenes, and floridin tars, but not pure paraffins and naphthene hydrocarbons, have been shown to produce carbon in the carbon residue test. (3) The type of engine carbon is of more importance than the quantity, it being shown after extensive road tests that a naphthenic base oil of relatively high carbon residue content caused less trouble with engine deposits and the engine required far less frequent cleaning than when using paraffin base oils. (4) Excessive quantities of oil above the piston, due to overfilled crank-cases, loose rings, and worn pistons, will cause excessive carbon formation. Faulty ignition or overheated engines or any maladjustments causing smoky combustion will also be contributing factors.

C. L. G.

532.* Four-ball Apparatus Predicts Hypoid Lube Performance. H. R. Kemmerer and F. L. Garton. *Nat. Petrol. News*, 27.12.39, **31** (52), R.551.—The four-ball apparatus for the testing of E.P. lubricants consists of an oil cup in which three steel balls may be clamped, so that each is in contact with the other two. A fourth ball is held above the other three in a member which can be rotated at a controlled speed.

During the test the fourth ball is in contact with the lower balls. The contact pressure is adjustable through a lever system. The oil-cup rests on a ball thrust-bearing and its rotation is limited by a spring. A graphic recording system records the torque. The test period is normally of 1 min. duration. Scoring time can be determined for any load, and by plotting these data the load to produce scoring at any particular time may be extrapolated. Reproducibility has been found to be best by determining the load required to produce scoring in 2·5 sec. Alternatively, the diameter of the wear spots on the lower balls can be measured. It has been found that a promising method of assessing the relative merits of different lubricants comprises the comparison of the extent of wear at 200° F. (93·3° C.) and 80° F. (26·6° C.).

This has led to the conception of the wear-temperature constant "*K*"

$$K \text{ Max.} = \frac{W_1 - W_2}{93{\cdot}3 - 26{\cdot}6} \times 1000$$

where W_1 and W_2 are the wear in mm. at 200° F. and 80° F., respectively, *K* being taken at the load where W_1 and W_2 are maxima.

H. G.

533. Hazard of Mercury Vapour in Analytical Petroleum Laboratories. C. F. McCarroll. U.S. Bureau of Mines, Report of Investigations No. 3475, October 1939.—Liquid mercury is in constant use these days in analytical petroleum laboratories, but so far little consideration has been given to the dangers occasioned by liberation of the toxic vapours—for instance, by accidental spilling of the mercury. Inhalation of mercury vapour and dusts is now recognized as definitely harmful to the human body, and there is already published an extensive literature on what is known as industrial mercurialism. This includes data on the disease in both its acute and chronic forms as contracted during the process of mining and smelting mercury-bearing ores, also in the hatter's fur-cutting industry. Owing to the comparatively rare incidence of chronic mercurialism in analytical laboratories and other concerns not directly engaged in these industries, few specific data are available in the former connection.

The author of this paper undertook certain investigations with a view to determining the concentrations of mercury vapour present under various operating conditions in analytical laboratories and to discovering ways of minimizing hazards attendant thereon. In addition, available literature on chronic industrial mercury poisoning was studied in an attempt to correlate these findings with conditions obtaining in petroleum laboratories.

Results show that the use of reagents, such as hydrogen sulphide, have proved successful in some instances in combating the effect of exposing liquid mercury in laboratories. Nevertheless, inasmuch as hydrogen sulphide is extremely toxic in itself, preventive measures of this kind should only be used by experienced operators having an intimate knowledge of the hazards of this gas.

H. B. M.

534.* Present Position Relative to Viscometry. F. Jostes. *Oel u. Kohle*, 1939, **34**, 663–665.—Empirical methods for the measurement of viscosity as used in different countries afford no accurate standard for comparison of oils. Accordingly attempts are being made to introduce absolute methods based on the capillary and falling-sphere viscometer. Thus in Germany the viscometers of Höppler, Ubbelohde, and Vogel-Ossag, are in use. The reliability of these viscometers depends on the accuracy of calibration, and at the World Petroleum Congress in London 1933 an international committee was established on this question. On two capillary viscometers calibrations of an accuracy of $\pm 0{\cdot}3\%$ and of $3{\cdot}0\%$, respectively, were reported. In the Brussels session, therefore, a resolution was reached whereby collaboration accrued between Physikalisch-Technische Reichsanstalt, Berlin, and Ecole Nationale Supérieure du Pétrole, Strasbourg. It was anticipated that complete agreement in calibration would be attained, and accurate conversion of empirical to absolute measurement established. Attention is also directed to the uncertainty existing in the measurement of flow properties of plastic substances, such as Krämer–Sarnow softening method for bitumen, the ring and ball and penetration tests, etc., none of which is satisfactory. It is suggested that a similar procedure as for viscosity outlined above is necessary. A. V. B.

535.* Determination of Phenols in Hydrocarbon Solvents. L. A. Wetlaufer, F. J. van Natta, and H. B. Quattlebaum. *Industr. Engng Chem. Anal.*, 1939, **11** (8), 438.—A 25-ml. sample of the hydrocarbon solvent is extracted five times with equal volumes of 0·2N-potassium hydroxide. Each extract is neutralized with 25 ml. of 0·2N-sulphuric acid and diluted to 100 ml. with glacial acetic acid. A portion is heated on a steam-bath with a few drops of concentrated sulphuric acid and nitric acid. A pale yellow colour develops. The solution is then cooled in ice and made alkaline by the gradual addition of concentrated ammonium hydroxide. The yellow colour is intensified and its depth is compared in a Duboscq or Klett colorimeter with that given by standard solutions prepared by carrying out the above procedure on solutions of known amounts of phenol (in water) and *p-tert.*-butylphenol (in acetic acid). The method is considered to be rapid and direct and gives checks within 5–10 parts per million. G. R. N.

536.* Determination of the Molecular Weights of Oils. W. E. Hanson and J. R. Bowman. *Industr. Engng Chem. Anal.*, 1939, **11** (8), 440.—The apparatus employed consisted essentially of a modified form of the Cottrell boiler and adapted for use with the Menzies–Wright water differential thermometer. Benzol and *cyclo*hexane were used, the former being preferred, since a good grade of the commercial product requires no further purification and may be used directly. Results on pure compounds and on a variety of petroleum products, mol. wt. range 200–1500, indicated a precision of 1% or better at all times. A complete determination of mol. wt. requires 2 hr. G. R. N.

537.* Determination of Total Sulphur in Asphalts. S. Pellerano. *Industr. Engng Chem. Anal.*, 1939, **11** (8), 446.—About 0·25 gm. of the asphalt is placed in a porcelain combustion boat and 3 ml. chloroform are added to dissolve the sample. 3–5 gm. catalytic combustion mixture (manganese dioxide–cupric oxide) are added and incorporated in and cover the asphalt solution. The chloroform is evaporated off and the boat is placed in the combustion apparatus. After combustion the contents of the boat are digested with boiling water and filtered. The sulphates in the filtrate are determined quantitatively using barium chloride. The results agree closely with those determined by the bomb method. G. R. N.

538.* Change in Solvency during Evaporation of Thinners. E. H. McArdle. *Industr. Engng Chem. Anal.*, 1939, **11** (8), 450.—A simple air-lift glass laboratory film evaporator is described; 100 ml. of "mineral spirits" and related solvency naphthas can be evaporated in the form of a film during less than 3 hr. at room temperature. Since aniline point is generally accepted as a measure of solvency of a hydrocarbon thinner of a given boiling range, this test was applied to small samples taken at regular intervals from the naphtha during evaporation. Graphs relating per cent. evaporated and

aniline point showed that the several naphthas tested possessed marked characteristics with respect to the change in solvency during evaporation. It was found that time and temperature within fairly narrow limits were not factors affecting the operation of the evaporator. G. R. N.

539.* Solvency of Petroleum Spirits. S. S. Kurtz, Jr., W. T. Harvey, and M. R. Lipkin. *Industr. Engng Chem. Anal.*, 1939, **11** (9), 476 and 484.—Part I. There is no definite relation between the kauri butanol solvency of petroleum spirits and the viscosity of cold-cut solutions of resins dispersed in these spirits. The resin solvency for cold-cut dispersions defined by the equation

$$\text{R.S.} = \frac{\text{kinematic viscosity of solution of X\% resin in standard spirit 1}}{\text{kinematic viscosity of solution of X\% resin in spirits under test}} \times 100$$

is approximately independent of the concentration at which the test is made and also of the temperature of test. The resins recommended for test purposes are: (1) Beckacite 1001, a straight phenolic resin and ester gum 6. The relative solvent power of spirits depends on the type of resin with which the resin solvency is determined. Spirits which contain approximately equal proportions of paraffins, naphthenes, and aromatics, however, have good solvency for any of the spirit-soluble resins. The logarithm of the kinematic viscosity is proportional to the concentration expressed as grams of resin per gram-mol. of solvent. The conclusions are confined to spirits or cuts lying within the boiling range of 300–400° F. 33 References.

Part II. Graphs are developed so that the resin solvency of spirits for phenolic and ester-gum resins can be determined from the A.S.T.M. 50% boiling point, the density (d 20/4), and the refractive index (n 20/D). Conversely, specifications of boiling point and resin solvency for these resins automatically specify the physical properties and approximate composition of the solvent. G. R. N.

540.* Determination of High Viscosities. E. L. Baldeschweiler and L. Z. Wilcox. *Industr. Engng Chem. Anal.*, 1939, **11** (10), 525.—The barrel of a Gardner mobilometer was fitted with a brass jacket so that water from a Hoeppler thermostat could be used to maintain accurate temperature control of the mobilometer during test. By rigid control of the temperature and time, it was found that the relation between absolute viscosity and mobility was a straight line at various temperatures, for high-viscosity oils—*i.e.*, 800 poises at 77° F., 300 poises at 150° F., etc. The slope of the straight line depended on the number of holes in the disc being steeper the fewer the holes. It was concluded that if care is taken the Gardner mobilometer can be used as a precision instrument to determine the absolute viscosity of viscous oils. G. R. N.

541.* Determination of Specific Gravity of Gases. G. V. Feskov. *Industr. Engng Chem. Anal.*, 1939, **11** (12), 653.—A description is given of an automatic effusiometer, which is considered more accurate than the regular manually operated type. It eliminates personal error in handling a stop-watch. Mercury is used as the displacing medium, whilst the automatic timing system is operated without a relay. The instrument is recommended for routine use in the determination of the specific gravity of petroleum gases. G. R. N.

542.* Capillary Flowmeter with Variable Orifices. J. H. Bruun. *Industr. Engng Chem. Anal.*, 1939, **11** (12), 655.—A simple flowmeter with a vertical capillary tube is described. The capillary tube was 60 mm. long and 1·1 mm. in diameter, being designed for the maximum gas flow expected. By inserting accurate wires in the capillary the gas flow could be varied according to the size of the wire. It was necessary to calibrate the flowmeter for each wire, and a range of 0·2–7·0 litres per minute gas flow for this capillary was obtained. G. R. N.

543.* Quantitative Determination of Aromatic Hydrocarbons. A. V. Grosse and R. C. Wackher. *Industr. Engng Chem. Anal.*, 1939, **11** (11), 614.—The method described is based on the measurement of the specific dispersion of the sample, and applies to

hydrocarbon mixtures boiling within the gasoline range. Either the Abbé or the Pulfrich refractometer can be used. The formula employed is as follows :—

$$\text{Wt.\% of aromatics} = \frac{\delta \text{ mixt.} - 0{\cdot}16 \times \text{bromine number} - 99}{\delta \text{ arom} - 99} \times 100$$

99 = specific dispersion of the saturates—*i.e.*, the paraffins and naphthenes, 0·16 = increment of specific dispersion per unit of bromine number. The theory underlying the method is given and checked, using a number of synthetic mixtures. Comprehensive tables are included. G. R. N.

Motor Fuels.

544. Co-operative Fuel Research Motor-Gasoline Survey, Winter 1938–39. E. C. Lane. U.S. Bureau of Mines. Report of Investigations No. 3455, June 1939.—The above report is the seventh of a series prepared by the Co-operative Fuel Research Committee and the U.S. Bureau of Mines. It includes data on 1875 samples representing the products of eighty-three different companies, and also data on samples from the Pacific Coast which were averaged by the Pacific Coast Technical Committee before submission. For the purposes of the report, gasoline is divided into three price-grades : regular, premium, and third-grade. Characteristics of each grade are reported, based on inspections made in oil-company laboratories and submitted to the Bureau of Mines for compilation and comment. Detailed study of these shows that gasolines in the various price classifications fall equally into definite groups in so far as their characteristics are concerned. H. B. M.

545.* Starting Properties and Volatility of Automobile Fuels. Z. V. Veksler and N. I. Kuzmin. *Neft. Khoz.*, July 1939, **20** (7), 40–44.—Tests were carried out in a tractor engine with seven petrols of varying volatility. The results show that a correlation exists between the ease of starting at varying temperatures and the temperature of 10% distilled, the equilibrium evaporation, and the vapour pressure determined according to the methods of Reid and Sorel—N.A.T.I. The 10% point has the greatest practical value, and the formula developed by G. G. Brown is confirmed. Basing on average summer and winter temperatures in the mean latitudes of the U.S.S.R. of +10 and −10° C., and considering a certain evaporation loss during transportation and storage, the 10% point of summer- and winter-standard petrol is recommended to be not higher than 75 and 60° C., respectively. L. R.

546.* Fuels and Tetraethyl Lead. F. Ramorino. *Chim. e Industria*, 1939, **21** (10), 578–580.—The author briefly summarizes the position in France and Germany with regard to fuel anti-knock characteristics and compression ratio of automobile engines. It is pointed out that, whereas in France the fuel is adjusted to meet the requirements of newly developed engines, in Germany the engine must fall into line with the self-sufficiency policy, and while a minimum octane number of 65 is prescribed by Government regulations in France, no vehicle is licensed in Germany unless it is able to employ a fuel of 74 octane number. The position in Italy is similar to that in France. It is stated that the production of alcohol in Italy is not sufficient to enable suitable blends, which would be stable under the climatic conditions, to be obtained, and since the average octane number of present supplies of gasoline is very low, the author suggests using sufficient tetraethyl lead to bring the octane number up to 65. Tetraethyl lead is now manufactured in Italy, and some latitude should be permitted in regard to the proportions which may be used, consistent with satisfactory operation of the engine, the addition of lead being prohibited during the period when the use of 10–20% of alcohol is obligatory. In conclusion, the author suggests that fuels of higher anti-knock characteristics should be introduced in order to conform with practice in other countries and to keep abreast of developments in the Italian automotive industry. P. G.

547.* Low Quality of Distillate Fuels Hinders their Use in Farm Tractors. E. L. Barger. *Nat. Petrol. News*, 15.11.39, **31** (46), R.482.—A plea is made for an improvement in the quality of distillate fuels. It is shown that whereas 90% of the farm trac-

tors in America are capable of running on distillates, the major part of the tractor fuel is gasoline. This is due to the variable and low average quality of distillates. Laboratory tests and practical ploughing trials have shown that although 70 octane gasoline gives the greater power output, distillate fuel has a considerable price advantage. A proposed specification for distillate tractor fuel is as follows :—

Octane Number 30 min.

Distillation.

Minimum	5%	not below	325° F.
	95%	,, ,,	464° F.
Maximum	10%	not above	400° F.
	25%	,, ,,	420° F.
	95%	,, ,,	515° F.
End Point		,, ,,	540° F.

The sulphur content and gum content may be higher than for gasoline. H. G.

548. Patent on Motor Fuels. Texaco Development Corporation. E.P. 516,521, 4.1.40. Appl. 30.5.38.—Production of anti-knock motor fuel hydrocarbons from a cracked distillate. The distillate is alkylated with a low-boiling *iso*paraffin—*e.g.*, *iso*butane or *iso*pentane in the presence of sulphuric acid. The *iso*paraffin is at least equal in weight to the weight of the olefines present in the cracked distillate.

See also Abstract No. 492. H. B. M.

Gas, Diesel and Fuel Oils.

549.* Application of Graphical and Statistical Methods to the Analyses of Diesel Fuels. J. C. Vlugter, H. I. Waterman, and H. A. van Westen. *J. Inst. Petrol.*, 1939, **25**, 678–683.—After a general discussion of these methods and of available data, it is concluded that a more thorough investigation of a large number of diesel fuels will be necessary in order to study the influence of chemical composition on the cetene or cetane value. G. R. N.

550.* Diesel Fuel Characteristics Influencing Engine Output. A. J. Blackwood and G. H. Cloud. *J. Inst. Petrol.*, 1939, **25**, 684–694.—The effects of volatility, ignition quality, viscosity, gravity, and heating value of diesel fuels are discussed and summarized. G. R. N.

551.* Evaluation of Certain Normal Alkylated Benzenes as Diesel Fuels. G. Shen, C. E. Wood, and F. H. Garner. *J. Instn Petrol.*, 1939, **25**, 695–703.—A paper, which describes the preparation and properties of the normal alkyl benzenes ranging from *n*-amyl to *n*-nonyl, and which gives their cetane numbers as determined on the C.F.R. diesel fuel-testing engine. G. R. N.

552.* Effect of Tractor Kerosine Admixture on Freezing Point of Diesel Fuel. I. A. Ptashinski. *Neft. Khoz.*, July 1939, **20** (7), 44–45.—Present Russian diesel fuel standards prescribe, in general, a freezing point not higher than —25° C. Tests have shown that a linear relation exists between the volume of kerosine added, up to 40%, and the reduction of the freezing point of diesel oil. The effect is small, and 10% of a kerosine freezing below —65° C. reduced the freezing point merely 2–3° C. The effect of paraflow on Surakhany gas-oil was considerable. The importance of using different components for blending summer- and winter-grade diesel fuels is stressed. A standard method of determining the freezing point of diesel fuels is required, whilst the freezing-point standard specification should be revised. L. R.

553.* Miscibility of Fuel Oils. —Demann. *Oel u. Kohle*, 1939, **38**, 685–686.—Fuel oils can be derived from L.T.C., H.T.C., syntheses and petroleum. The miscibility of two fuel oils of different source or origin is defined by flocculation of hard asphalt and free

carbon. In absolute miscibility no precipitation of asphalt or carbon occurs, and these are assumed absent. Relative miscibility expresses to what extent a fuel oil containing hard asphalt and free carbon is miscible with other oils. In opposition to absolute miscibility, it is dependent on constitution of the added oil.

There are two main groups of fuel oil, the one asphaltic preponderately of aromatic naphthenic structure, and the other asphalt free of predominantly aliphatic nature such as some petroleum origin fuel oils.

These two groups, when mixed, cause flocculation of asphalt. It is stated that by deasphalting asphaltic fuel oils complete miscibility of oils from L.T.C., H.T.C., or syntheses ensues. A. V. B.

Lubricants and Lubrication.

554.* Oxidation Resistant Motor Oils Producible by Present Methods. M. R. Fenske, C. E. Stevenson, and R. E. Hersh. *Nat. Petrol. News*, 15.11.39, **31** (46), R.471.—Although the degradation of a lubricating oil may have many aspects and symptoms, the chief basic cause of the degradation is oxidation. Information relative to the degree of oxidation resistance of a lubricant may be obtained by considering the neutralization number and volatile-acid-forming characteristics of the oil, together with its oxygen absorption curve at constant time and/or constant temperature and the rate of change of viscosity index with time in service.

Little information is at present available concerning the chemical constitution of lubricants, but such work as has been carried out indicates that an increase in this knowledge should throw considerable light on the problem. At the present time the application of solvent extraction to the refining of lubricants and the addition of anti-oxidants to lubricating oils have been responsible for a noteworthy improvement in their oxidation resistance. H. G.

555.* Hypoid-Lubricant Requirements. H. R. Wolf. *Oil Gas J.*, 17.11.39, **38** (27), 162.—The development of hypoid lubricants from the motor-engineer's point of view is discussed. Attention is directed to the need for differentiation between lubricants used under widely different conditions. To distinguish between a hypoid lubricant suitable for high-speed operation of passenger cars and one suitable for low-speed operation in trucks, the names "passenger-car duty hypoid lubricant" and "truck-duty hypoid lubricant" have been used. The word "duty" is included to emphasize that operating conditions, and not the type of vehicle, must be the determining factor in the choice of lubricant. General Motors' procedures for test of both types of lubricants are described in detail, and grades recommended for their vehicles have to satisfy specified requirements.

In a consideration of future developments of hypoid gears it is considered that requirements with respect to lubricant are likely to become more critical, so that new types of extreme-pressure addition agents may have to be developed. R. J. E.

556.* Some Aspects of Steam-Engine Lubrication. J. D. Watson. *Fuel Econ.*, 1939, **15**, 329–331.—The requirements of lubricating oil for steam engines and of reciprocating air compressors, which have much in common with steam engines, are reviewed. Lubrication feed-systems receive noteworthy attention.

Acidity and tendency to gum are stressed as being of paramount importance in choosing a steam-engine lubricant, and a warning is sounded against any misconception of the value of viscosity and flash point, etc. The use of branded oils from reputable firms is commended.

In the case of reciprocating air compressors it is essential to deliver air as free from oil as is possible and to avoid an excess of air in the cylinder—one of the main causes of faulty valve operation, with the attendant risk of explosion.

The high temperatures prevalent in air compressors induce carbonization, and the oil must be judged accordingly. It is considered that a heavy oil is not necessary—a light oil is more easily atomized and is more completely burned away by the heat. If the lubrication is kept to the minimum requirements, there is no danger of explosive vapours.

A suitable oil should have a flash point of at least 400° F. and low carbon formation.

A light oil is best, providing it has sufficient body to stand up to 150° F.—the temperature of the cylinder walls—and seals the rings without oil drag.

Oils prepared from an asphaltic-base crude are preferable to those prepared from a paraffinic base, because the carbon formation from the latter type is considered to be much harder than that from asphaltic-base oils. T. C. G. T.

557.* Behaviour of Various Engine and Gear Lubricants in Seizure Tests. D. Clayton. *J. Inst. Petrol.*, 1939, **25,** 709–728.—A paper in which the results are described of an investigation of the effect of various lubricants on the seizure characteristics of hard steel in the four-ball apparatus. Some discussion is given of the applicability of the results to gear lubrication. G. R. N.

558.* Practical Methods of Testing Lubricants. J. H. Evans. *J. Inst. Petrol.*, 1939, **25,** 729–750.—The various kinds of greases and lubricants are discussed with reference to their composition and characteristics as revealed by the test methods employed by the Timken organization. G. R. N.

559.* Test for the Ring Sticking Properties of Lubricants. J. C. McNichol, C. G. Williams, and P. V. Lamarque. *J. Inst. Petrol.*, 1939, **25,** 751–759.—A description is given of a simple laboratory test for assessing the oxidation and ring-gumming propensities of engine lubricants. It consists principally in measuring the strength of a thin oxidized film of the lubricant. The test results are discussed in relation to the service characteristics of lubricants. G. R. N.

560.* Extreme Pressure Lubricant Tests with Pretreated Test-Pieces. J. P. Baxter, C. I. Snow, and I. T. Pierce. *J. Inst. Petrol.*, 1939, **25,** 761–770.—Experiments with the Timken and Four-Ball lubricant testing machines are described in which considerable increases in the breakdown loads of doped and undoped oils were obtained by pretreatment of the test-pieces with chlorinated or sulphurized dope or with hydrochloric acid. G. R. N.

561.* Testing of Engine Lubricants. C. A. Bouman. *J. Inst. Petrol.*, 1939, **25,** 771–778.—A paper which gives a critical survey of the laboratory testing of lubricants and their interpretation in making a choice of a suitable motor oil. G. R. N.

562.* Lubricating Oils by Solvent Treatment of Lignite Coal Tars. M. Marder. *Oel u. Kohle*, 1939, **33,** 649.—Lube oils comparable to naphthene-base petroleum oils stated to be obtained by selective solvent treatment of lignite coal-tars; specific gravity, asphalt content, coke number, and viscosity temperature characteristics are in improved contrast to those of an acid-refined oil. Mention is made of a subsequent treatment of the raffinate with small quantities of condensation agent, aluminium chloride. The reaction product after vacuum distillation shows a further improvement in properties. A. V. B.

563.* Oil Filters. J. E. Hurn. *Refiner*, 1939, **18** (10), 405.—To determine whether an oil will be a satisfactory lubricant, it is necessary to estimate the moisture, corrosive materials, and asphaltenes, because these cause the formation of sludge and lacquer, which are responsible for engine wear. The asphaltenes must be removed from the oil as fast as formed and while they are still in the liquid state. They increase in viscosity as the temperature rises, and tests were made to determine the temperature at which they become more viscous than the oil. The tests showed that when the viscosity of the oil was reduced to about 100 sec. S.U., the asphaltenes could be separated by using an absorbent filter, not a strainer. The proper use of filters makes it unnecessary to change the oil at the usually stated intervals. Trucks tests are cited which show the advantages of filtration with regard to longer use of the oil and reduction in cylinder wear. G. R. N.

564. Patents on Lubricants and Lubrication. E. F. Pevere. U.S.P. 2,186,271, 9.1.40. Appl. 25.6.36. Manufacture of a cutting oil comprising a light mineral oil having a

viscosity within the normal range for the lubrication of cutting tools and 2–10% by weight of an organic polysulphide.

B. H. Lincoln and W. L. Steiner. U.S.P. 2,186,646, 9.1.40. Appl. 20.2.39. Production of lubricant incorporating lubricating oil and a small percentage of sulphurized synthetic ester of a low-molecular-weight monohydric or dihydric alcohol and a high-molecular-weight organic acid.

N. Geiser. U.S.P. 2,187,704, 16.1.40. Appl. 20.12.35. Method of manufacturing lubricating oil from olefines by adding aluminium chloride as polymerizing catalyst, and thus obtaining a hydrocarbon mixture consisting mainly of aliphatic hydrocarbons and being rich in olefines. Subsequently the polymerizing catalyst is separated from the lubricating oil and used again.

P. G. Colin. U.S.P. 2,187,802, 23.1.40. Appl. 25.9.37. Mineral hydrocarbon oil for lubricating bearings which have substantially the corrosion susceptibility characterizing cadmium–silver, cadmium–nickel, and copper–lead alloys. The oil is such that it would normally tend to corrode these surfaces, but the addition of suitable proportions of tin tetra-butyl to the oil prevents this.

Union Oil Company. E.P. 516,276, 28.12.39. Appl. 17.3.39. Manufacture of mineral lubricating oil containing 0·8–3% oil-soluble metal soap of saponifiable petroleum acids produced by the oxidation of petroleum fractions. The soap is present in sufficient quantity to control deposition of gummy and resinous materials and overcome ring-sticking tendencies in severe service internal combustion engines. The oil product has practically the same viscosity as the original mineral lubricating oil.

E. I. Du Pont de Nemours and Co. E.P. 516,182, 27.12.39. Appl. 22.6.38. A small proportion of an acetal containing at least one free hydroxyl group is incorporated in lubricating oils and greases to aid in providing thin film lubrication and retard sludge formation. H. B. M.

Asphalt and Bitumen.

565.* Adhesiveness of Bitumin to Silica Sand. H. F. Winterkorn and G. W. Eckert. *Industr. Engng Chem. Anal.*, 1939, **11** (10), 546.—McLeod's mixing test and the authors' wash test are compared. It is concluded that the ease of covering a sand with a bituminous material by means of simple mixing may be a general indication, but is not a dependable measure of the adhesion relationship between the bitumen and the sand. The best agreement of the mixing-test data with those from the wash test occurs where wetting agents are used in conjunction with aluminium, iron, and lead ions—*i.e.*, with those ions which are generally recognized as favourably affecting adhesion of bitumen to aggregate. For such cases, and where the aggregate has to be coated in the wet condition with the help of soap-type activators, the McLeod test appears to have some merit. The mixing test cannot be substituted for the wash test if definite information on the adhesion relationship between bitumen and aggregate is desired. G. R. N.

566. Physical Properties of Bitumen. P. C. Blokker. *Angew. Chemie*, 1939, **52**, 643–648.—The authors have surveyed the literature on the physical properties of bitumen and collected together a mass of data which they have supplemented by their own tests. The latter were confined to commercial bitumens of Venezuelan and Mexican origin. The latest designs of testing apparatus are described in detail. E. W. S.

567. Bituminous Stabilization Practices in the United States. L. Muir, W. Hughes, and G. Browning. *Highway Res. Board Proc.*, 1938, **18** (II), 306–313.—Owing to cost, local materials must be used when possible for U.S. roads, and stabilization with bitumen provides a method of economically rendering these materials suitable for use, since it makes the soil resistant to water and increases its natural stability. It is generally conceded that moisture is essential, and that for best results compaction must be carried out at the optimum moisture content, determined by the Proctor test.

Less moisture is required the less viscous the bitumen. Complete mixing of bitumen and material is essential. All types of bituminous materials have been used, but the contradictory statements made in various States show that much remains to be learned regarding the types, grades, and methods of manipulation best suited for any particular purpose. Construction methods are similar in all States reporting the use of asphaltic oils. Generally good results have been obtained by those using residual and cutback oils. The general behaviour of tars has been found to be substantially the same as that of asphalt. The general practices of all States using asphalt emulsions are substantially the same, and it has been found that (1) ample water must be available, (2) the stack must be kept moist at about the plastic limit until mixing is complete, and (3) spreading, rolling, and dragging must be done when the material is at the proper consistency, which is about the optimum water content. It is important that the asphalt emulsions should contain no appreciable amount of soap or other soluble emulsifying agent. In Missouri, Idaho, and California it has been found that emulsions disperse much better through the soil than other asphaltic materials, but they must be stable, capable of mixing with water, must lose water rapidly, and must be uniformly dispersed as a light film on all soil particles. It has not yet been proved whether the increased cost of the emulsified product is followed by longer life. A *résumé* of the practices used in the following States is given: Missouri, South Carolina, North Carolina, Kentucky, Ohio, Iowa, Nebraska, Florida, Wyoming, California, Idaho, and Nevada. Formulæ for ascertaining the amount of bitumen required on a project are given by Iowa and Nebraska States, whilst Florida has been unable to develop a formula, and uses the method of trial laboratory mixes, whilst pointing out the need for warm, dry weather during construction.

It is concluded that all bituminous materials can be used successfully under the proper conditions, that the bitumen must be thoroughly admixed with the soil, and that efficient drainage is of the first importance. H. G. W.

568. Compendium on Soil Testing Apparatus. C. M. Johnson and E. S. Barber. *Highway Res. Board Proc.*, 1938, **18** (II), 371–433.—This is a compendium, complete with illustrations and details, of the physical tests used in soil laboratories in U.S.A., Canada, and Europe. It is pointed out that if further details are required, reference must be made to the original papers. The subject-matter is divided into nine sections with tests as outlined. .

Consolidation tests give information on the amount and rate of consolidation of soil samples due to pressure. In all types the sample is placed between two porous stones, provision is made for the water extruded in the process, and a piston is used to transmit the pressure (cf. *ibid.*, 9–33). The apparatus is grouped according to the pistons and method of applying the load.

Direct shear tests determine the resistance of soils to distortion (cf. *ibid.*, 9–33), and are grouped into the box, plate, double, and torsion methods, the normal loads being applied in three ways, while the shearing loads are applied in five ways.

Compression tests on soil cylinders give information on the distortion and volume change of soils when under known compressive stresses. The sample may be confined on all faces as in the fixed and free rubber types, or open and loaded only on the ends in the unconfined type (cf. *ibid.*, 9–33).

The compaction test determines the densities for varying moisture contents so as to show the maximum dry density. The devices are grouped into impact, static, and vibration (cf. *ibid.*, 9–33).

Capillarity tests determine the amount, rate, and height of water taken up and held by soils, and the apparatus is divided into four groups: open-tube, negative-head, compressed-air, and indicator.

The permeability test is useful for determining the amount of water under pressure which will flow through soils under various conditions. The permeameters are divided into three types, depending on the method of applying the head of percolating water—viz., constant-head, variable-head, and horizontal capillarity, whilst the sample containers are also divided into individual, consolidometer, and Proctor mould.

The penetration and extrusion tests furnish data on the relative bearing capacity of soil samples, and some may be used *in situ*. Four groups are considered—viz., needle, cone, bearing, and extrusion.

If a soil is not already saturated, the swell test will show the increase in volume

obtained on the absorption of water. Consolidometers may be used as well as the Proctor mould and Californian apparatus.

Field tests and sampling equipment are described, including the portable surface shear-testing-machine, the combination-foundation exploration drilling-rig, and various soil samplers. H. G. W.

569. The Trend of Soil Testing. C. A. Hogentogler and E. S. Barber. *Highway Res. Board Proc.*, 1938, **18** (II), 9–34.—This paper consists of a *résumé* of soil-test methods and points out the significance of the test data. Clays are adsorbed by the sand to various extents, and the resultant wet mixtures may or may not have air in the interstices, depending on the electrical attraction between the materials. The adsorbed moisture is called the film moisture, and is found mainly on the colloidal particles; decreasing the ratio of free to film moisture increases the soil stability. This may be effected by reduction of the temperature and by replacement of the natural ions with others which have greater attraction for water; at the "critical" moisture content the abrupt change from the plastic to the semi-solid state is observed. The purpose of soil tests is to disclose in some manner the effect of moisture and air content of samples on the bearing value and stability of soil masses, and the four general types of test are: (1) consolidation, (2) shear, (3) compaction, and (4) indicator, all carried out at constant temperature. The "voids ratio" is defined as the ratio of the volume of the pores to the volume of solids. In test (1) the time–pressure and moisture content-pressure curves are obtained as characteristics of the soil, and if the shape of a building, etc., is known, the amount and rate of consolidation it produces in the soil can be determined, and the distance it can settle without lateral displacement of the undersoil. In test (2) the theory and method of test are given, and it is found that sand shears abruptly and clay only after considerable deformation. It is seen from the stress–strain relationships that only part of the soil strength can be used in construction. The speed of embankment construction, for example, can be so controlled that the pore pressure, shown by stand pipes in the undersoil, will not be developed to such an extent as to make failure imminent. From tests (3) can be determined the maximum soil density possible and the corresponding optimum moisture content, and from these data can be found the safe height of embankment for soil compacted to a given density. The tests (4) which indicate the engineering properties of the soil are the plasticity tests and mechanical analyses and are used so that suitable soils can be obtained by blending. H. G. W.

570. Soil Stabilization with Tar. G. E. Martin. *Highway Res. Board Proc.*, 1938, **18** (II), 275–282.—By the proper use of tar, as described, existing soils can be made resistant to water, and their bearing power can be materially increased. Sand, etc., may be added to the soil to increase its bearing power, but a tar stabilized soil, however, does not depend on the grading for its stability. In general, soils containing more than 5% of material passing the no. 200 sieve will be materially improved by the addition of sand, etc., and the heaviest grade of tar which can be mixed satisfactorily should be used. The amount of tar generally lies between $\frac{1}{4}$ and $\frac{1}{2}$ gall./sq. yd./in. of consolidated depth, and a formula is given for calculating the amount required for a given project. The optimum moisture content can be determined by the Proctor method, and a 4-in. consolidated depth at least should be carried out. Details of the tests used are given, but these are at present only tentative. It is required that the soil shall be so treated with tar as to give a capillary water adsorption for 14 days of not more than 25% of that of the untreated soil. Specimens are prepared by means of the standard moulds and tampers used in the Hubbard–Field stability test; moisture and apparent density determinations are made on these, and the conditions to give maximum weight per cubic foot are determined under the conditions of compaction used. The percentage of water absorbed on immersion in water after 14 days is also determined. The specimens are tested for stability in a Hubbard–Field Stability Testing Machine before and after immersion in water and satisfactory mixes derived from these results. The large-scale construction methods are then given complete with illustrations. These are mixing with aggregate if required, loosening and pulverizing the soil, adding water followed by tar, mixing, consolidating (generally by sheepsfoot roller) and adding a "tack coat." The seal coat should not be added until the moisture content

is reduced to 6–8%. Improvement in mixing and consolidating machinery may be expected. H. G. W.

571. Bituminous Emulsion Stabilized Roads. C. L. McKesson. *Highway Res. Board Proc.*, 1938, **18** (II), 283–288.—It has been found in general, that, if a small amount of bitumen in the form of a suitable emulsion is mixed with clay-bearing soils and allowed to dry, an entirely changed material is obtained, which can be used in place of imported aggregates. A careful laboratory study has shown that the emulsion particles became admixed with the soil colloids during mixing, and on evaporation the particles formed thin bitumen films, which were adsorbed on the soil. Hence the cementing value of the soil colloids, due to water, was replaced by that due to bitumen. According to the author the bitumen was adsorbed so well that only a small portion could be recovered by the usual solvents. Too small an amount of bitumen did not render the soil water-resistant, and too much (still below the usual binding quantities) lubricated the soil so that it lost its natural stability. Two tests were used for estimating the efficiency of the treatment: (1) to measure the resistance to aqueous capillary absorption and (2) to measure the resistance to plastic flow of the material after it had absorbed as much water as it would. The author reached the conclusion that, of two equal soils with equal water contents, that containing asphalt was the more stable. The amount of emulsion required to act as a continuous coating can be reduced by introducing imported gravel, the final complete process then being cheaper. The author states that considerably more research is required and that a well-stabilized foundation with only a thin asphaltic wearing surface is preferable. It is also considered that the emulsified bitumen should be mainly of microscopic and sub-microscopic size, so that the whole of the soil colloids are coated, and that unrestricted loss of water should be possible. The most important construction items are proper mixing, adequate compaction, thorough drying and proper surface protection, and the author discusses the practical aspects of each of these. It has been found in practice that, if considerable water enters the bottom of the stabilized layer during drying, a thin layer should be laid first and allowed to dry, or the bottom surface should be treated with emulsion, cut back, etc. before placing the stabilized material on top. An adequate surface course is necessary to prevent the stabilized soil raveling under traffic and to protect from surface leakage. For soils subject to flooding considerably more fines, and hence bitumen emulsion, are required. Another satisfactory addition is the application of a penetrating prime coat to the surface of the dry stabilized base before applying the surface course. H. G. W.

572. Asphalt Emulsion Stabilization on Cape Cod (Massachusetts). A. V. Bratt. *Highway Res. Board Proc.*, 1938, **18** (II), 289–291.—Contrary to the rest of Massachusetts, this is an area of fine, poorly graded sand only. Owing to the high cost of properly constructed secondary roads, it was found necessary to stabilize the base courses instead. Details of experiments made with asphalt emulsions as soil stabilizers are given, the formulae being derived by means of the Hubbard–Field Asphalt Stability machine. The author considers that in cohesionless materials, like this sand, it is essential to establish a base upon which to start compaction. H. G. W.

573. Asphaltic Binder Stabilized Roads. F. V. Reagel. *Highway Res. Board Proc.*, 1938, **18** (II), 292–298.—The author gives the general history of soil stabilization and shows how by the use of bitumen, soil can be stabilized without or with the addition of only limited quantities of granular materials. In Missouri it has been found that if the soil is between 40% and 60% of the total soil aggregate mixture it can be stabilized by about 8% bitumen based on the weight passing the no. 40 sieve. Details of the three methods used in this State are given—viz., (1) the plant mix method, (2) the suboiling method—in which the water and bitumen, etc., are introduced by tubes below the surface of the prepared soil, and (3) the road mix method, which has been developed from method (1). The author points out that test methods are not yet standardised, but are concerned with

(*a*) determination of the granulometric composition of the soil material to be treated,

(*b*) determination by the original or Proctor test of the moisture content inducive to best compaction of the soil material and

(*c*) the testing for water affinity of soil mixtures which have been treated with varying amounts of the admixtures contemplated for use.

Besides the usual tests, it is considered that repeated freezing, thawing, wetting and drying tests are necessary. The use of bitumen in soil stabilization is to prevent excessive swelling and softening of the soil, but not to reduce the natural cohesive strength due to its adsorbed water. The bitumen best does this when present as a fine lattice-work rather than the absolute coating of each particle, which would probably result in the entire loss of the desirable soil characteristics. In non-cohesive soils the function of the bitumen is to increase cohesion by cementing the soil particles together, and the bitumen must be chosen for the purpose required. The use of emulsions can only be justified if their superiority can be shown by actual experiment. The author concludes by pointing out that no reliable method exists, other than empirical, to determine the necessary depth of stabilization required under given conditions, and if found would save considerable sums of money. H. G. W.

Special Products.

574.* New Aviation Gasoline Ingredient. Anon. *Oil Gas J.*, 5.10.1939, **38** (21), 40.—The manufacture of neohexane (2 : 2-dimethylbutane) has been accomplished in the pilot-plant stage by the Phillips Petroleum Co., and will shortly be commercially available for incorporation into aviation gasoline. It will be manufactured by thermal alkylation from ethylene and *iso*butane, using a furnace temperature of 900° F. and a pressure of over 1000 lb. per sq. in. Neohexane has the following properties : specific gravity 0·6498, boiling point 121° F., Reid vapour pressure 9·5 lb. The octane number is 95, and owing to its high volatility, it is not necessary to add straight run gasoline, as in the case of *iso*-octane. Blends of neohexane, *iso*pentane, and *iso*-octane, with the addition of lead, will provide an adequately balanced aviation gasoline of O.N. 115. Neohexane has a better lead susceptibility than *iso*-octane at higher octane ratings, although a little poorer at low ratings.

It is estimated that there is sufficient *iso*butane and ethylene (or ethane) in the U.S. to manufacture 1,000,000,000 gal. per yr. of neohexane. C. L. G.

575.* Catalytic Oxidation of Olefinic Hydrocarbons. W. L. Faith and M. S. Dendurent. *Refiner*, 1939, **18** (10), 393.—Amylene may be converted into maleic acid by vapour-phase oxidation over a V_2O_5 catalyst. At temperatures between 350° and 500° C. from 12 to 22% conversions into maleic acid are obtained. The optimum temperature is about 425° C. Variations in space velocity and air–amylene ratio have little effect on percentage conversion. Hexene, heptene, and octene also yield maleic acid by the same process. Conversions are higher than those from amylene, and appear to increase as the number of carbon atoms in the hydrocarbon is increased. A discussion of economic possibilities of the process is given. G. R. N.

576.* Fractionating Equipment for Obtaining Special Products in Natural Gasoline Plants. H. C. Givens. *Petrol. Engr*, Nov. 1939, **11** (2), 51.—A description is given of a six-column fractionation unit designed to separate propane, butane, *iso*pentane, *n*-pentane, hexane, and cleaners' naphtha from natural gasoline. The recovery of these products is estimated to increase the revenue per gall. of gasoline manufactured by 50% (under maximum fractionation conditions) at an increased material and labour cost of 20% over that of a normal natural gasoline plant. The highest plate efficiency in the columns is necessary. For propane extraction a 15-in. spacing between the trays is recommended, whilst for the heavier cuts 12-in. is adequate. For the extraction of propane, butane, *iso*pentane, or mixtures, a column of 26–30 trays gives the best results, for normal pentane and hexane 22 trays, and for all heavier cuts 12–15 trays. The diameter of the column is based on the charging rate, a ½-in. of cross-section being allowed per gal. of liquid feed per hr. In general, reflux is preferably fed by pumping from the ground accumulators rather than by gravity from a condenser on the top of the column, where a gasoline of freed vapour pressure is to be

made. For special-product manufacture, however, overhead condensers are more easily controlled and cheaper to operate. Reboilers are preferably built into the foot of the column, and should be of larger size than usual for ease of control, and the steam heating should be controlled by a low-sensitivity air-operated temperature recorder controller of the reset type. Back-pressure regulation of the column is best controlled by the air-operated recorder or indicator-controller of high sensitivity connected to an air-operated motor valve. A flow controller on the charging-pump is a useful adjunct. Standard cooling and condensing equipment may be used; a heat transfer of 1 B.Th.U. per min. per sq. ft. of surface per degree logarithmic mean-temperature difference being allowed. C. L. G.

577. Dihydronaphthalene Polymers. N. D. Scott and J. F. Walker. Symposium on Plastics and Resins from Hydrocarbons. *Amer. chem. Soc. Meeting, Boston*, Sept. 1939, 93–99.—There are two isomeric dihydronaphthalenes: (1) 1 : 4-compound prepared by the reaction of Na with a solution of naphthalene in absolute alcohol and with m.pt. 24·5–25·0° C.; (2) 1 : 2-compound produced by the quantitative rearrangement of the 1 : 4-derivative on exposure to a hot solution of sodium ethylate—m.pt. −8° to −7° C. Literature on the polymerization of these products is scanty.

The 1 : 2-dihydronaphthalene reacts with sodium naphthalene ($C_{10}H_8Na_2$) to form a polymer in the form of a colourless powder which does not melt at 250° C. and chars at a point only somewhat below red heat. It is completely insoluble in water and most organic solvents. Under different conditions, polymerization to a brittle resin m.pt. 165° C. and mean molecular weight 749 is obtained. Dimerization of the 1 : 2-derivative with sulphuric acid yields a light-yellow viscous liquid distilling 235–250° C. at 15 mm. pressure.

The 1 : 4-compound will also react with $C_{10}H_8Na_2$ to form brittle hydrocarbon resins and a colourless material, m.pt. about 100° C. and mean molecular weight 400–450 can be obtained. A liquid dimer distilling 195–205° C. at 1 mm. pressure can also be formed. Resins obtained from the 1 : 4-compound are brittle, glass-like solids, refractive index 1·6, insoluble in water and alcohol, moderately soluble in gasoline, and very soluble in a number of organic solvents. Dihydronaphthalene resins can be hydrogenated, and this effects improvement in their properties, especially colour stability. D. L. S.

578. Influence of Chemical Composition upon the Properties and Uses of Certain Vinyl Resins. S. D. Douglas. Symposium on Plastics and Resins from Hydrocarbons. *Amer. chem. Soc. Meeting, Boston*, September 1939, pp. 101–110.—Polyvinyl chloride is an unusually strong and water- and chemical-resistant resin, but it softens so slowly with rise in temperature that decomposition begins before it can be properly moulded. Polyvinylacetate, on the other hand, softens just above atmospheric temperature, is brittle, and has a relatively high water absorption.

When these monomeric vinyl compounds are polymerized simultaneously, a resin is obtained that combines the strength and water-resistance of the chloride with the beneficial properties of the acetate. This co-polymer type of resin has the following industrial uses.

Surface Coatings. The resin used for this purpose has molecular weight 8500–9500, contains 85–87% vinyl chloride, and is used in solution in ketones supplemented by aromatic hydrocarbons.

Coated Paper.—This resin is similar in composition to the above type, but has molecular weight 9500–10,500. In this application suitable modifiers including pigment, plasticizer, and stabilizer are incorporated.

Phonograph Records—Floor Tile.—Identical with resin used for paper coating.

Injection Moulding.—Most suitable for this process is a resin of molecular weight 9500–10,500 and a vinyl chloride content of 85–87%. This allows of maximum strength and toughness in the moulded article and adequate fluidity at the moulding temperature.

Compression Moulding.—A resin of average molecular weight 12,000–13,000 and containing 85–88% vinyl chloride is generally used.

Sheet-Stock Resin.—In the manufacture of plastic sheets outstanding strength and toughness are required, but as high plasticity at moulding temperatures, as for in-

jection moulding, is not necessary. Thus a resin of molecular weight 15,000–16,000 and containing 88–90% vinyl chloride is used.

Synthetic Textiles.—Two types of resin have been developed, both containing 88–90% of the chloride, one with molecular weight 16,000–19,000 and the other 20,000–23,000.

Coated Wire.—A resin with molecular weight 20,000–22,000 and containing 95% vinyl chloride has been successfully used for this purpose. D. L. S.

579. Polystyrene. A. J. Weith, V. H. Turkington, and I. Allen, Jr. Symposium on Plastics and Resins from Hydrocarbons. *Amer. Chem. Soc. Meeting, Boston*, September 1939, pp. 111–119.—The lower polymers of styrene—molecular weight 20,000–30,000 or below—are characterized by low mechanical strength and brittleness, as contrasted with the toughness of the higher members of the series. The latter serve as ideal material for the injection moulding process.

The thermal stability of polystyrene can be considered from two angles. Long exposure at temperatures above 100° C. causes a decrease in molecular weight without formation of volatile products. The second type of breakdown is more or less complete thermal decomposition or pyrolysis, resulting in the formation of a large percentage of volatile products. The first type of breakdown has been shown to be due to surface oxidation. The second does not become evident until a temperature of 330–350° C. is reached—*i.e.*, 100° C. or more above the temperature used in the practical applications of polystyrene.

When the polymer is heated in a distilling-flask to 360–375° C., a fairly rapid distillation of liquid products takes place, and in a case cited 80% distillate was obtained containing 50% styrene.

The high-molecular-weight polymers are incompatible with most of the ingredients commonly used in paints and varnishes, but recent work has made practical the production of polymers of relatively low molecular weight which are readily soluble in drying oils to form oleo-resinous finishes.

Styrene is formed as a by-product in various hydrocarbon cracking processes, and it is expected that a large supply of this material will be available in the near future. D. L. S.

580. Study of the Effects of Lubricating Oils on Neoprene Vulcanisates. D. F. Fraser. Symposium on Plastics and Resins from Hydrocarbons. *Amer. Chem. Soc. Meeting, Boston*, September 1939, pp. 121–132.—In writing control specifications for fabricated neoprene parts a volume increase test after immersion in a lubricating oil is frequently included.

Experiments were carried out by immersing specimens of vulcanized neoprene compound in thirteen different oils at various temperatures. It was found that after a short time the compound showed a maximum swelling in each oil and the oil–neoprene system attained a swelling equilibrium. This equilibrium was reached more rapidly in the case of those oils having the least effect, and the length of time before equilibrium was reached decreased with rise in temperature. Swelling was found to increase with increase in the temperature of immersion.

Neoprene is very resistant to members of the paraffin group of hydrocarbons, whereas naphthenes cause severe swelling and aromatics a very severe swelling.

As a result of this work it has been shown that at swelling equilibrium the percentage volume increase is a logarithmic function of the viscosity–gravity constant, and that there is a direct relationship between percentage volume increase at equilibrium and the gravity indices of the oils used.

There is no simple correlation with specific gravity, refractive index, or viscosity index. D. L. S.

581. Production of Phenol from Benzol by Means of the Raschig Process. W. Mattes. *Angew Chem.*, 1939, **52**, 591.—This process works without pressure and is continuous and catalytic. It differs from all other methods hitherto used, in that there is no consumption of chemicals. Production is carried out in two stages: (1) chloro-benzol is made from benzol, hydrochloric acid and air, (2) the chlorobenzol is saponified with steam and transformed into phenol and hydrochloric acid. The chief problem was to

find a catalyst which would make it possible to work at a temperature low enough to ensure that no benzol would be burnt during chlorination. The catalyst is composed of activated aluminium chloride in combination with copper salts. Higher chlorinated benzols—*e.g.*, dichlorobenzole, etc., up to hexachlorobenzole—are also obtained.

A plant producing 1400 tons per year has been working in Germany for several years, and another plant to produce 20 tons per day is under construction in the U.S.A.

E. W. S.

582. Patents on Special Products. A. Lazar. U.S.P. 2,186,248, 9.1.40. Appl. 30.4.34. Manufacture of an emulsifying oil incorporating unsaturated and aromatic hydrocarbons derived from heat treatment of a petroleum fraction heavier than kerosine and containing organic acids.

C. L. Schuttig. U.S.P. 2,186,308, 9.1.40. Appl. 25.2.36. Manufacture of sulphonated oil by reacting a fatty oil with sulphuric acid, treating the reaction mixture with an aqueous salt solution, and allowing to settle in order to produce an aqueous layer. The aqueous layer is then separated from the sulphonated product and alkalised. The mixture is finally allowed to stand until the sludge containing the unsulphonated oils and fatty acids separates as an upper layer.

V. Ipatieff and H. Pines. U.S.P. 2,187,034, 16.1.40. Appl., 17.12.36. Production of alkylated aromatics by subjecting a mixture of an aromatic hydrocarbon and an olefin of higher molecular weight than butylene to depolyalkylation.

H. J. Robertson. U.S.P. 2,188,770, 30.1.40. Appl., 20.11.37. Production of mineral-oil sulphonic acids by subjecting the oil to sulphonation, adding to the reaction product, while agitating, a sufficient quantity of an aqueous alkaline solution to neutralise the sulphuric acid in the reaction product. The sulphonic acids are finally separated by stratification.

J. E. Pollak. E.P. 516,024, 20.12.39. Appl. 20.6.38. Method of preparing drying oils wherein Isano-oil is mixed at room temperature with one or more drying or semi-drying oils of vegetable or fish origin.

Deutsche Hydrierwerke A.-G. E.P. 516,188, 27.12.39. Appl. 11.7.39. Method of manufacturing capillary-active substances whereby organic hydroxyl compounds of the general formula R–Ar–OH or metal compounds thereof, in which R stands for a substituted or unsubstituted aliphatic or *cyclo*aliphatic residue containing at least three carbon atoms and Ar stands for an aromatic residue, are reacted with a benzyl chloride sulphonic acid or a salt thereof.

May and Baker, Ltd. E.P. 516,288, 29.12.39. Appl. 23.6.39. Preparation of amino-substituted pyridine-sulphonamides of the type $NH_2{\cdot}B{\cdot}SO_2NR'R$, where B is the pyridine radical and R′ and R may be hydrogen or an alkyl, aryl, or aralkyl group, and when R is hydrogen R′ may be a pyridine residue, by condensing the sulphonyl chlorides $NH_2{\cdot}B{\cdot}SO_4Cl$ with ammonia, alkyl-aryl, or aralkyl-amines or amino-pyridine compounds.

André Marie Ghislain Maurice Luyckx. E.P. 516,329, 29.12.39. Appl. 20.7.39. Catalytic preparation of liquid hydrocarbons from carbon monoxide and hydrogen. This comprises contacting a mixture of the said gases at atmospheric pressure and at a temperature between 200° and 215° C. with a finely divided binary uranium oxide cobalt catalyst on an inert support.

George William Johnson. E.P. 516,352, 1.1.40. Appl. 9.5.39. Catalytic conversion of carbon monoxide with hydrogen into hydrocarbons with more than one carbon atom in the molecule, in contact with stationary catalysts and in the presence of liquid medium containing a considerable amount of constituents which are gaseous or vaporous under the reaction conditions.

Distillers Company, Ltd., and Thomas Bruce Philip. E.P. 516,360, 1.1.40. Appl. 6.3.39. Apparatus for carrying out the conversion of alcohols to olefines by dehydrating catalysts in the gaseous phase. The apparatus comprises a number of catalytic

reaction chambers connected in series by conduits through which the reactants pass, a temperature control unit to each reaction chamber, etc. H. B. M.

Detonation and Engines.

583.* Cooling of Diesel-Engine Pistons reduces Lacquer Formation. A. T. McDonald and L. A. Blanc. *Nat. Petrol. News*, 15.11.39; **31** (46), R.494.—Practical experiments carried out on a small-bore diesel engine were designed to investigate the condition conducive to piston deposits and lacquer formation. It was concluded that the products of combustion contribute little in these respects, provided that combustion is properly controlled. There were indications that such deposits may be aggravated by the effect of hot blow-by gases, consisting almost entirely of air, and acting on thin films of lubricating oil.

Reducing the piston temperature by oil or water-cooling reduces the tendency for carbon and lacquer deposits, but since this is not a practically possible device, the use of compounded lubricating oils is the more feasible way to minimize fouling. The type of fuel used, if kept within the limits of distillate fuels commercially available, has practically no influence on piston deposits and ring-sticking. H. G.

584.* Engine Bearings—from Design to Maintenance. A. B. Willi. *J. Soc. aut. Engrs*, 1939, **45** (6), 513—525.—It is considered that there are six major causes of bearing failures. Excluding corrosion troubles, the lubricant is seldom to blame, provided reputable oils are used. Four classes of lining material are commonly used: tin-base babbits, high-lead babbits, cadmium alloys, and copper–lead mixtures. Each has its own field of usefulness, and these fields are defined in terms of maximum unit pressure, Zn/P, PV, oil reservoir temperature and crankshaft hardness. Unfavourable design factors are considered, including oil-flow to the rod-bearing, restrictions in oil-feed grooves, oil-clearance, and mechanical considerations. Photographic illustrations of typical failures are included. K. A.

585.* Aircraft Engines and their Lubrication. A. Nutt. *J. Soc. aut. Engrs*, 1939, **45** (6), 501–512.—The author reviews past and probable future development of aircraft engines, with special reference to the work of Wright Aeronautical Corporation. In fourteen years the output of the "Cyclone" engine has been raised from 400 to 1200 h.p.; the B.M.E.P. has been doubled, the speed raised from 1900 to 2500 r.p.m., and the specific weight halved. This evolution is attributed to improvements in cooling, supercharging, crankshaft design, spark-plugs, fuels, oils, dynamic suspension, and materials. Discussing these features he foresees further refinements in air-cooling, giving less sensitivity to detonation and better performance, together with a considerable increase in the use of exhaust turbo supercharging during the next five years. There is a need for better spark-plugs.

A comparison is drawn between the Junkers compression-ignition engine and an equivalent gasoline motor, leading to the conclusion that the aircraft diesel has little prospect of overtaking the spark-ignition type in performance. A more likely trend is the use of the so-called safety type of fuel in injection engines with spark ignition. The author has no doubt that there will continue to be scope for both air- and liquid-cooled motors.

It is claimed that the introduction of new oil specifications has produced a definite improvement in available lubricants. The deposition of oxidation products often sets a limit to the permissible hours run between overhauls, and better resistance to oxidation must be achieved. The author considers that oil refiners must intensify their research work if the desired advance in high-output engines is to materialize. K. A.

586. Henschel-Lanova Air Chamber Diesel for Coal Tar Oil. E. Scheruga. *Brennst. Waermewirt.*, 1939, **21**, 199–202.—The ignition temperature of coal-tar oil is 66° C., as compared with 350° C. of a suitable diesel fuel. Early designs of diesel engines for tar oil employed for initial ignition a pilot drop of gas oil in each injection. Later, the Hesselmann spark ignition engine gave a smooth operation with tar oil. The diesel

engine with precombustion chamber was also able to run on tar oil if special incandescent grids were inserted in the cylinder. The author describes an air-chamber engine—also with heat convector—which gives good results with coal-tar oil if the intake air is heated during idling speed and half load. Under full-load conditions the ignition temperature in the cylinder is reached without preheating the intake air.
E. W. S.

587.* Efficient Burning of Fuel in High Speed Oil Engines. A. T. Wilford. *J. Inst. Petrol.*, 1939, **25**, 649–656.—A paper which gives an account of the measures taken by a large passenger-transport organization to ensure efficient combustion of the fuel used in its oil-engined vehicles. The application of exhaust-gas analyses to combustion control is discussed. G. R. N.

588.* Experiments with Doped Fuels for High-Speed Diesel Engines. J. J. Broeze and J. O. Hinze. *J. Inst. Petrol.*, 1939, **25**, 657–677.—The subject is thoroughly discussed under the following items: requirements from a dope, influence of a dope on the ignition delay of a fuel, the effect of a dope on the combustion process, and the influence of a dope in a fuel on wear and incrustations in the engine. G. R. N.

589.* Piston and Piston Ring Temperatures. P. V. Keyser and E. F. Miller. *J. Inst. Petrol.*, 1939, **25**, 779–790.—The subject is discussed under the following items: piston deposits, methods of measuring piston temperature, cylinder-wall temperature measurement, laboratory experiments, effect of design on piston temperature. G. R. N.

Coal and Shale.

590. Sulphur in Products of Combustion of Fuels. L. R. Burdick and J. F. Barkley. U.S. Bureau of Mines, Information Circular No. 7065, May 1939.—Sulphur in the atmosphere is regarded as a potential source of much damage, since it readily unites with oxygen to form corrosive acids. Its source is usually traceable to the burning of fuels containing sulphur, and in this connection investigations have been made to discover, if possible, what actually happens to the sulphur—*i.e.*, how much of it remains in the refuse, how much is carried away with the gases, and how much lodges in the fuel-burning equipment. The authors of this Circular review published information on these questions. H. B. M.

591.* Toxicity of Coal-Tar Naphtha Distillates. H. Taylor. *Chem. and Ind.*, 1939, **58**, 1078;1080.—Coal-tar naphtha distillates are being used for the fumigation of houses against bed-bugs, and it is generally supposed that no detrimental effect on human beings ensues. This supposition is not supported by the author, who has conducted a series of experiments to determine the physiological effect of the naphtha vapour on rats.

All the samples of naphtha tested showed definite narcotic action at concentrations greater than 0·10% by volume, and in one experiment a single exposure of 6 hr. at a concentration of 0·16% caused the death of all the experimental rats.

There was considerable variation on the effect on internal organs with different samples, but definite liver degeneration was caused by two out of four samples, and slight effects were noted in the case of a third. T. C. G. T.

Economics and Statistics.

592.* Technology, Employment and Output Per Man in Petroleum and Natural Gas Production. O. E. Kiessling. Work Projects Administration, National Research Project. In co-operation with U.S. Bureau of Mines. Report E-10, July 1939.—In 1937 the output of petroleum and natural gas reached a peak for the United States, but employment in the industry did not rise commensurately. A fundamental economic problem raised by this fact was whether growth of employment in the oil

industry has been permanently arrested, and what are the probable employment opportunities in the future. These constitute the essential objectives of the investigations dealt with in this report. It is pointed out that from an economic standpoint the oil and gas industry is far more ramified than merely raw-material production, in that, apart from the actual producing oil-wells, it includes refineries, natural gasoline plants, oil and gas pipe-lines, and delivery of refined products to consumers (marketing). Consequently, the broadest view of this complicated industry is taken in this study, which, while economic in perspective, is at the same time inevitably technical in treatment.

The main sections of the report are devoted to long-time trends in production, employment and output per man; influence of migration to new flush-production areas; development of exploration and discovery techniques; development of drilling techniques; technologic advances in production and progress in natural gas and gasoline recovery; difficulties incident to increasing productivity; advances in transportation and storage techniques; technical advances in refining and employment prospects in the industry.

Among the interesting points elucidated in the course of this survey are that the industry has the highest annual gross income in the American extractive industries; that its total employment is second only to the coal industry; that it supplies more than a third of that country's total energy requirements; that, in spite of considerable progress in preventing waste, contemporary practices by no means represent efficient production from a strictly technical standpoint, though by increased refinery efficiency double the amount of petrol is now obtained from a barrel of crude oil than formerly. The main conclusion reached is that the outlook promises increased opportunities for employment, but that advances in the technology generally will alter the "composition of the working force." Unskilled labour is disappearing, particularly in the development, refinery and transport branches of the industry; trained technicians and skilled workers are replacing the old-time "roustabouts"—in short, the industry is being run by specialists, and vocational training is now the qualifying factor in recruiting personnel for all branches. H. B. M.

593. Industrial Research in 1939. W. A. Hamer. *Chem. and Chem. Engng News*, 10.1.40.—It is estimated that in the U.S.A. in 1939 almost 32,000 scientific men and 16,000 assistants were engaged in research on behalf of 2000 firms. The chemical, petroleum, and electrical laboratories employed nearly half of the total industrial research workers. B. T.

594. Oil in Brunei. Anon. *Bull. Imp. Institute*, 1939, **37** (4), 629.—In a report received from the British Resident oil produced in the second quarter of 1939 amounted to 186,062·94 tons, and in the third quarter 195,126·5 tons. These figures are net production after allowing for water run-off and pumping losses between field and refinery. H. B. M.

595. Assessment of Petroleum Production in Rumania During 1939. Anon. *Monit. Petr. Roum.*, 1940, **41**, 3–7.—The effects of hostilities in Europe are traced in economic aspects of the Rumanian oil industry during 1939. It is indicated that not only belligerent countries, but also neutrals are anxious to obtain ample stocks of petroleum products. So far, the only marked effect in the Rumanian industry has been an increase in the price obtained for such products.

The prices of various crudes during each month of 1939 are tabulated. These indicate a steady increase, amounting to 50% by August and leaping to a 196–259% increase (according to crude) by the end of the year.

The prices of refined products, again tabulated, have not had such spectacular advances, but these have registered price increases of 92—136% over the year.

Drilling in Rumania reached its peak in June with 28,172 metres, compared with 18,857 in January and 21,000 in December.

Production has remained fairly steady, with no increase towards the end of the year. The maximum monthly figure was 538,719 tonnes in March and the minimum 497,025 in February.

The greater part of the crude produced is processed, and this again has showed no

remarkable change, though the November figure of 430,000 tonnes is only 86% of that for January.

In the export market monthly crude exports reached a peak in February with 44,455 tonnes, whilst the November figure was 25,060. Refined products had their peak export period of 386,762 tonnes in April, and have fallen away towards the end of the year to 274,828 in November.

Internal consumption has shown a steady increase during the latter months of the year, rising from 115,421 tonnes in June to 180,000 in November.

Comparing the 1939 statistics with previous years it is apparent that the marked decline since 1935 in the export of Rumanian petroleum products has been continued. In 1935 the total exports were 6,611,000 tonnes, and in 1939 4,150,000 tonnes.

T. C. G. T.

596. Statistics on the Rumanian Oil Storage Capacity. Anon. *Monit. Petr. Roum.*, 1940, **41**, 63–71.—The average oil storage of 43 named companies is analysed according to the particular petroleum product and its location—*i.e.*, field, refinery, or port storage. All these statistics are then condensed in one table.

From the condensed table it is seen that the total of petroleum crude and products held in the country amounts to about 3 million tonnes, in 5000 storage units, 1780 field units store 588,000 tonnes, 2830 refinery units hold 1,555,000 tonnes and 390 port storage tanks hold 840,000 tonnes. Constanza with 290 tanks holds 765,500 tonnes of the port storage.

Astra-Romana on an average holds 614,567 tonnes, or 20·49% of the country's total, Steaua-Romana holds 14·5%, Concordia 10·87%, and Romano-Americana 10·56%.

The figures do not represent the maximum possible amount held in storage, but merely average stocks. Further, they do not include large quantities of material held in unrecognized storage—*e.g.*, in wooden tanks or in pits in the fields. T. C. G. T.

597.* 1938 Crude Production Results and 1939 Perspectives of Azneftedobycha. K. A. Mashkovich. *Az. Neft. Khoz.*, January 1939, **19** (1), 16–20.—The 1938 plan of crude-oil production has been fulfilled 98·5%, that of gas production 93·3%. Oil and gas production have increased 772·7 thousand tons over 1937 figures. The main reasons for the non-fulfilment of the plan are examined and necessary measures to improve production given. L. R.

598.* Records of Yields in the Argentine Oilfields. M. Soifer. *Bol. Inform. Petroleras*, November 1939, XVI (183), 55–63.—Modern methods of exploitation are based on getting the most out of every deposit of oil by maintaining or increasing the pressure by injecting gas or by introducing water in order to secure maximum recuperative results at the finish. In order to achieve the desired result, it is necessary to have, for reference, the most exact possible records of production, of gas and of water in the oil-bearing zone, in conjunction with the results obtained from each well individually. The author develops the subject in detail, describing the necessary measuring apparatus, tank batteries, etc., for different types of wells, explains the calculations, and shows the different forms which should be used for keeping the necessary records.

H. I. L.

599.* Further Legislation governing Oil Companies in Brazil. Anon. *Bol. Inform. Petroleras*, November 1939, XVI (183), 69–72.—This note refers to the law No. 961 of 17.12.38 by which the holding of shares, etc., in Brazilian oil companies and refineries is restricted to Brazilian nationals. The note contains additional clauses regulating the holding of shares by husband or wife when the parties are married, and where one of the parties is a foreigner.

The decree No. 1369 of 23.6.39 is also published, transferring to the National Petroleum Council the functions in respect to oil which have hitherto been controlled by the Ministry of Agriculture. H. I. L.

600.* World Legislation concerning Petroleum. Anon. *Bol. Inform. Petroleras*, November 1939, XVI (183), 74–84.—This record of world legislation, which was

started with No. 174 of this journal, includes Paraguay, Persia, Peru, Poland, and Rumania among other countries. H. I. L.

601.* Decrees by the Argentine Government concerning Purveyors of Petrol, Gas Oil, etc. Anon. *Bol. Inform. Petroleras*, November 1939, XVI (183), 85–91.—Decrees published regulating the period for which a licence will be granted to purveyors of petrol and the like, regulating the methods of measuring cargos and freights for inter-port transport, prohibiting the export of any kind of fuel, ensuring declaration of destination and ports of call by all ships of the merchant marines of all countries, limiting the amount of bunker fuel that may be shipped by boats leaving the Argentine for oversea ports, fixing of maximum prices for kerosine and other fuel oils, permitting the reshipment of petrol to Brazil and Paraguay, permitting the export of petroleum and its derivatives to Paraguay, regulating prices of fuels, etc. H. I. L.

602.* Export of Petroleum Products from Rumania during 1939. M. Pizanty. *Monit. Petr. Roum.*, **41**, 5, 1.3.40, 249–260.—This is an authoritative and detailed statement of the export trade in petroleum products of Rumania during 1939. The value of these products (11·2 milliards of lei) represented 41·9% of the total value of exports of all merchandise—the largest single item in Rumanian foreign trade. Total petroleum exports were 4,177,571 tons (4,494,762 tons in 1938). The distinctive feature of 1939 was the increase in exports from Giurgiu and the decrease in exports from Constantza. The following are the principal statistical Tables included :

From official sources (Statistique financière et economique).

1. Exports by product and country of destination (1938–39). The principal features of this Table are as follows :

Consigned to :	Crude Oil.	Motor Spirit.	Kero-sine.	Gas and Fuel Oil.	Lubri-cants.
	(In thousands of tonnes.)				
Germany, Czechoslovakia and Austria	196	636	206	234	9·5
United Kingdom	—	347	137	119	16·2
Italy and Albania	23	83	106	419	4·6
France	22	148	46	22	—

2. Exports by product and port of consignment (1938–39).
3. Monthly values of exports by product (1939).
4. Annual quantities of petroleum products exported (1930–39).
5. Exports through Giurgiu by ownership of tank-barges (1936–39).
6. Exports from Constantza by nationality of tanker (1939).
7. Monthly quantities by countries of destination (1939).

From statistics supplied by oil companies.

8. Exports from different companies classified by product and port of consignment (1939).
9. Exports from different companies classified by product and country of destination (1939).

Information supplied by oil companies indicated a total volume of exports of petroleum products of 4,095,443 tons. This source of information is independent of that derived from Customs returns which appear in the official statistics. The difference in the two totals is less than 2%. S. J. A.

BOOK REVIEWS

Volumetric and Phase Behaviour of Hydrocarbons. By Bruce H. Sage and William N. Lacey. pp. 299. Stanford University Press, California, 1939. Humphrey Milford, Oxford University Press, $5.00.

The quantitative application of scientific principles in petroleum technology has been retarded by the lack of data, but in recent years a considerable amount of quantitative experimental knowledge of hydrocarbons has been accumulated. The majority of this information has resulted from experimental studies carried out by the authors of this book through the American Petroleum Institute's Research Project 37.

In this book the quantitative liquid–gas phase behaviour of hydrocarbons with emphasis on volumetric behaviour is dealt with, and the subject discussed finds its major application in processes handling natural gas and natural gasoline.

Without a doubt the logical and scientific treatment of this subject has never before been equalled, and the authors are to be congratulated on their work.

After the preface and list of symbols employed, the book opens with an introductory chapter on general definitions and phase equilibrium, followed by a useful chapter on the mathematical concepts involved.

The one-component system is next dealt with in the order gases, liquids, two-phase region, and critical region. Twenty out of the twenty-three diagrams appearing in this chapter are quantitative in nature, and deal exclusively with saturated hydrocarbons, mostly methane, ethane, propane, and butane.

In chapter four, two-component systems are discussed in the order, single-phase region, two-phase region and three-phase region, with proper emphasis on critical behaviour, the diagrams being about equally divided between illustrative sketches and quantitative figures.

The discussion on three-component systems is confined almost entirely to liquid–gas phase behaviour, and is the most comprehensive and exhaustive description of this subject so far published. It is here that the lack of quantitative data is most pronounced, this chapter being the only one in the book where the authors have been forced to employ illustrative sketches rather than quantitative diagrams.

The chapter on multi-component systems is outstanding. Here an attempt is made to describe the behaviour of multi-component systems in the light of experimental data available on such diverse and complicated materials as natural gas, gasoline, crude oil, and natural gas–crude oil mixtures. The inclusion of such a chapter in a book on phase equilibrium is a welcome novelty, and the authors are to be complimented on their initiative and courage. Nearly every one of the many diagrams included in this chapter is quantitative in character, and the text is destined to be long quoted as a classic.

The work is continued with chapters on the phase rule, partial quantities, and ideal solutions, and concludes with a short appendix on retrograde condensation.

The illustrations are clear, and out of a total of 194 a large proportion are quantitative in character and supplied with references to the original data in the literature.

No one engaged in quantitative work on hydrocarbons or petroleum can afford to be without a copy of this book. T. G. HUNTER.

De la Carbonization aux Carburants d'Aviation Vol. 1. Le Pétrole et ses Succédanés. By Ch. Berthelot with a preface by G. Claude. pp. 327. Published by Dunod, 92 Rue Bonaparte, Paris 1939. Price 107*frs.* Paper cover, 90*frs.*

This volume is the first of a series of three, which will include coking, gas production, and carbonization in general.

In an interesting foreword Claude directs attention to the need, due to the impact of war, to draw from one's own resources by an enormous industrial effort all

materials that are indispensable, neglecting those the precarious arrival of which might well prove a special danger to the community. He points out that M. Berthelot has put forward "une idée titanesque"—the production of 25,000,000 tons per annum of gasoline or substitutes before the right exists "de dormir tranquille," in which he contemplates the use of coal shales, lignites and wood.

Apart from the topical interest of the subject, the author has produced a well-balanced account of the sources and production of fuels alternative to petroleum.

He begins with an account of the Falmouth Committee, the report of Sir David Rivett to the Australian Government, and the progress put forward by the Labour Party on the oil-from-coal situation. Then follows an *exposé* of the corresponding position in France, where, in the event of hostilities, he visualized the trebling of peace-time requirements. Petroleum from Morocco, colonial wood, fatty oils, and alcohol are briefly discussed, and then the general development of the carbonization of shales, cannels, and other bituminous material in France, Scotland, and Estonia, with a critical examination of the various methods adopted in oil production. The utilization of compressed gas is detailed and the various methods of storage are described. Low-temperature carbonization in England, France, and Germany, and the retorting practice therein involved, are given due consideration.

In a very careful and thoughtful summing up of his conclusions he points out that France in war-time will need from 15 to 25 million tons of fluid fuel a year. He asserts that nine-tenths of all material received overseas by the Western Powers arrives by the Atlantic, and that in the last war 200,000 tons of shipping were sunk in the course of one week. All these facts, he says, demand the development of a self-contained policy. Autarchy is veritably in the air.

He makes a very pleasant reference to the Institute's Glasgow conference on Shales and Cannels in 1938, and justly points out that the petroleum industry is very far from opposing the technique of the carbonization process, knowing well the value of its long experience.

Your reviewer, although in general agreement with M. Berthelot's thesis that every reasonable attempt should be made to increase the supply of indigenous fluid fuel, would wish to emphasize this fact, perhaps more cogent for Great Britain than for France: The ultimate success of the Allies depends on the maintenance of the open seas. Without command of the oceans we shall surely perish, not so much for the lack of oil, but of food, and of that trade which is so vital.

A. E. DUNSTAN.

Sulphated Oils and Allied Products: Their Chemistry and Analysis. By D. Burton and G. F. Robertshaw. Pp. 163 + iv. A. Harvey, Publisher, 17, Leather-market Street, S.E. 1. Price 12*s.* 6*d.*

The book commences with a very interesting historical survey of the sulphation of oils from Fremy and Runge's experiments on the action of concentrated sulphuric acid on olive oil to the recent work on the analysis of petroleum sulphonic acids. The compounds which have been isolated from the oils used for sulphation are given, together with the occurrence of each acid or alcohol. The methods of the preparation of a few sulphated oils are described, whilst some of the modern refinements by which the action of the acid is controlled are illustrated. Although much is still to be learned regarding the mechanism of sulphation, this monograph contains a useful chapter on the "Chemistry of Sulphation," in which are discussed the various main reactions occurring.

However, the real service of this book is the complete guide to the analysis of sulphated oils, sulphated fatty alcohols, and petroleum sulphonic acids. Complete schemes of analysis for all these products are tabulated. Furthermore, each test, of which full experimental details are given, is reviewed critically, and the analyst is told where wrong conclusions may be reached owing to a deficiency in the test. The book will undoubtedly be invaluable to all who have to deal with both the analysis and development of these complex products, particularly as very full lists of reference are given at the end of each chapter. A foreword has been written by Professor T. P. Hilditch, D.Sc., F.I.C.

F. A. FIDLER.

BOOKS AND PUBLICATIONS RECEIVED

1. **The Waverley Handbook.** Ninth Edition. Compiled and edited by S. G. Symons. Pp. 902. Waverley Oil Works Company, Pittsburgh, Pennsylvania.

The editor and publishers of this Handbook tried to condense " the most complete and comprehensive text as yet made available to those interested in the Petroleum Industry " in between the 902 pages constituting this edition. How far they have succeeded is a matter of opinion ; but it must be admitted that at least an extensive field has been covered with regard to lubricating oils and lubrication in general. The ambitious claim cannot be entirely justified with a complete omission of such subjects as drilling for, and storage and transport of oil—to mention only three major items.

The volume contains 18 chapters dealing with lubricating-oil properties and their preparations, animal and vegetable oils, fuel oil, crude-oil production records, gasoline preparation and treatments, secondary recovery methods, dealing particularly with gas- and water-drives, benzole, A.S.T.M. standard methods of testing oil properties, meters for oil and gasoline. Chapters dealing with general problems include those discussing business law and banking tables for weights, measures and capacities, workshop formulas and what are termed " Waverley formulas," dealing with multitudinous and varied subjects.

References are attached in abundance to most chapters.

2. **Carbon Monoxide. Methods for the Detection of Toxic Gases in Industry.** Department of Scientific and Industrial Research. Leaflet No. 7. Pp. 9. H.M.S.O., London. Price 1*s.* 6*d.*

The standard method developed for the detection of carbon monoxide in industry consists in drawing samples of the atmosphere under test through a known area of test-paper, treated with palladium chloride, at a slow and constant rate, by means of a 5-litre aspirator. Interfering gases are removed by allowing the sample to pass first through a tube of activated charcoal. Sampling is continued until a stain is produced on the test-paper which compares with the standard colour chart, a copy of which is included in the pamphlet. The concentration present is then determined by comparing the time required to reach the necessary colour with the times given on the chart.

3. **Report of the Road Research Board for the Year ended 31st March, 1939.** Department of Scientific and Industrial Research. Pp. viii + 172. H.M.S.O., London. Price 3*s.* 6*d.*

This report contains a summary of progress of the work carried out during the year under review on (1) Soil Mechanics, (2) Materials and Methods of Construction, and (3) Road Mechanics.

Attention may be directed to the work on bituminous binders, which includes a comparison of durability tests with road performance of surface dressings and thin carpets containing these binders. Full-scale trials are in progress on tar-rubber binders designed in the laboratory for surface dressing and for thin surfacing, and a series of carpets containing asphaltic binders has been laid on the Colnbrook By-Pass with a view to relating their physical properties with road behaviour.

ABSTRACTS.

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Geology.

603.* New Interpretation of the Structure and the Oil Occurrences of the Horst–Wipshausen Area, N. of Peine, Hanover. L. Riedel. *Oel u. Kohle*, 1.2.40, **36** (5), 39–44.—The occurrence of oil in the Horst–Wipshausen area has been known since the 1880's, and from then until 1924 a number of wells were drilled, almost all of which gave small quantities of oil, but none a reasonable production. The idea that good oil deposits could be found at shallow depths was finally discounted by the two Greiser wells, drilled in 1934.

The Diluvium in this area is about 30 m. thick, and rests on the Senonian. The Senonian itself is transgressive, the lowest horizon being the *Mucronata* zone. Below this is found the Albian. Stoller considered, on the basis of the depths to the top of the Lower Cretaceous, that a gentle but narrow arching of the strata occurs immediately to the west of Horst and strikes approximately north to south. Unfortunately, the old well logs are not exact, and since, in addition, the Lower Cretaceous was not zoned, it is impossible to get a correct picture of the structure. Between Rietze and Dedenhausen there are a number of step-faults which probably strike north-north-east to south-south-west. It appears probable that still more step-faulting has taken place in the Horst–Wipshausen district itself. In addition to the faulting there has been a certain amount of folding, but the axis of this more likely trends east-north-east than north, as Stoller suggested. Torsion balance data support this view.

The oil is associated with clay-ironstone in the Lower Albian. This clay-ironstone is not in the usual form of nodules, but occurs as fragments which are full of cracks filled with oil. The reservoir is composed of lenses of clay-ironstone which are water-bearing, the oil collecting on the top of the water. If this oil is removed, more gradually collects to take its place, and after a few months, production can be resumed. The origin of the oil is doubtful: it may come from deeper horizons in the Lower Cretaceous, or it may have migrated up fissures from great depths, possibly from the Zechstein. S. E. C.

604.* Western Oklahoma Receiving Increased Exploration. B. Altman. *Oil Wkly*, 12.2.40, **96** (10), 20, 22, 26.—7 ml. south of Elk City a well entered the Pennsylvanian at 6577 ft. and was still in it at 14,582 ft. Thick sand bodies were present, and gas was found at 10,896–920 ft.

In the Western Oklahoma basin 10,000 ft. of Pennsylvanian beds were deposited in some areas, and the older beds dip steeply.

A test in Kingfisher County was completed for 12 brl. of high-gravity distillate and 2,500,000 cu. ft. of gas from a dolomitic limestone at 7357–60 ft. In Caddo County a Binger producer found the pay at 9900–83 ft. in the Pennsylvanian. Near Carnegie a thinning of the upper beds brings the Pennsylvanian, Mississippian, Devonian, Silurian, and Ordovician nearer the surface than elsewhere, and numerous shows of dead black oil were found on the north slope of the truncated Wichita uplift. The Wilcox was found at 9184–88 ft.

Structures have been mapped seismically on the top of the Mississippian, and Pennsylvanian reflections are easily obtainable. G. D. H.

605.* Oil Possibilities in the "Last Wilderness." W. C. Lehman. *Oil Wkly*, 19.2.40, **96** (11), 18–19.—Oil-seeps have long been known in the Olympic Peninsula of Washington. A well drilled in 1939 gave gas with 2½ gal. of gasoline/1000 cu. ft. In 1932 a little oil was found at a depth of 700 ft. 2 ml. north of the mouth of the River Hoh. A second well showed the fold in question to be so strongly faulted that there had been a serious loss of pressure. A 6000-ft. test 15 ml. north-east of the mouth of the Hoh was abandoned in 1937, although electrical cores had shown favourable signs.

The west side of the peninsula is a remnant of a large Tertiary basin. The main formation (Hoh) consists of Oligocene–Miocene marine beds, up to 30,000 ft. in thickness, and containing interbedded lenses of material of terrestrial origin. This formation is highly organic in the shale parts and there are coarse sandstones. There is complicated folding and faulting. G. D. H.

606.* Partition of Poland's Oil Industry. D. E. Morgenstern. *World Petrol.*, November 1939, **10** (11), 32–39.—In 1938 Poland produced 3,801,000 brl. of oil, and its thirty-seven refineries had a capacity of 8,700,000 brl./yr. The area annexed by Germany gives 35% of the oil and consumes about 80%, whilst the total consumption was 90% of the production.

Polish drilling practice is not very progressive, and in 1938 41% of the total footage was drilled by the Canadian system. Of the 3740 wells, only 20 flow; 903 are bailed and swabbed; the rest are pumped. Air-lift and water-flooding are almost unknown.

The oil-fields lie in four zones: (1) Magura, (2) Median, (3) Marginal, (4) Deep Marginal. The Magura zone is the least important as regards production. The structures are complex. At Mecina Wielka oil is found in the Cretaceous Ropienka beds, whilst at Sekowa–Ropica Ruska it is in the Upper Cretaceous Inoceramus beds.

In the Median zone the Gorlice–Sanak region is on a great anticline which involves Cretaceous–Oligocene beds. The oil horizons are the Oligocene Krosno beds and the Menelitic shales; the Eocene Ciezkowice sandstone and red and green shales, and the Cretaceous sandstones. In the Marginal and Deep Marginal zones oil is recovered from the Jamna sandstones (Cretaceous), the Menslite shales, Polanica formation and Dobrotow sandstone (Upper Eocene), the Boryslow sandstone and Middle and Lower Eocene horizons.

The structure, producing horizons, extent, and production of the various fields are briefly described. G. D. H.

Drilling.

607.* Largest Submersible Drilling Barge Combines Best Features of Marine Design. H. L. Flood. *Petrol. Engr*, February 1940, **11** (5), 31.—The paper describes a recently completed drilling barge which is believed to be the prototype of current barge design. It is one of the largest vessels which have yet been constructed for deep-drilling purposes. It is equipped to be operated by steam, supplied by boilers mounted on smaller companion barges.

The complete barge follows the conventional pattern of most submersible drilling barges, in that it comprises two identical hulls joined by transverse trusses to provide a slot or space between the hulls as a means of moving-off the site after the well is completed. The connecting-trusses are bolted to the hulls. The drilling-derrick has to be dismantled during the move.

The derrick floor and principal working level of the barge is 15 ft. above the deck of the hulls, supported by massive steel members constituting the superstructure of the barge proper.

The rest of the barge deck is occupied principally by the reserve mud storage units, each of which is built directly on the deck-plates as a base. Decked-over, the top surfaces of these tanks serve as pipe-racks upon which drill-pipe and casing may be stored.

Details are given of the mud system, draw-works, rotary-table, and other features of the drilling-barge under separate sections.

It is not necessary to dredge or otherwise prepare a platform to provide a level resting-place for the barge. This is partly because most lakes and bayous have fairly level bottoms, and partly because the weight of the barges displaces the mud usually present and automatically prepares its own bed.

In calculating stability the most severe conditions pictured as a design basis includes 12,000 ft. of 9⅝-in. casing suspended in the hole and 14,000 of 4½-in. drill-pipe standing in the derrick. Wind load was assumed at 70-mi/hr. A. H. N.

608.* Deepening and Completing a Well—Study in Modern Co-operative Practice. Part I. P. D. Torry and F. H. Miller. *Petrol. Engr*, February 1940, **11** (5), 155.—The paper is not a specific study of drilling, completion, or production practice, but it is rather a descriptive narration of some of the significant incidents and operations connected with one particular project. Little emphasis has been placed on theoretical considerations; detailed attention has been devoted to performance and to the many other factors that may assist in the other deep wells and the more effective production of oil and gas.

The paper is divided into five parts: (1) Geology, (2) Drilling, (3) Completion, (4) Production Tests, and (5) Considerations of Pressure Maintenance, Gasoline Recovery, and Gas Repressuring in the Shallow Producing Horizon of the Lisbon Field, Louisiana. A. H. N.

609.* Internal-Combustion Engine Used in California Deep Drilling. W. A. Sawdon. *Petrol. Engr*, February 1940, **11** (5), 173.—The drilling of a well to below 11,000 ft. with a gas-engine-powered rig has demonstrated the adaptability of internal-combustion engines to meet the requirements of deep drilling when conditions make the selection of this type of equipment advantageous.

Perhaps the most important factor in selecting the type of prime move is the availability of water or fuel, or both. Boiler troubles due to feed-water containing calcium or other deleterious substances in higher quantities than certain minima are naturally avoided whenever possible, and frequently can be eliminated only by eliminating the boiler itself. Under such conditions, and where natural gas is available for fuel, the gas-engine can be used as a prime mover.

When natural gas is not available, gas-engines in many instances are now converted to burn butane by the addition of heaters, no change in carburettors being necessary. Gasoline is seldom used for rotary drilling—the reasons are discussed in detail. Diesel engines have been used to some extent when natural gas is not available, and even when steam can be used. Fuel consumption is frequently an important item which has governed the selection of internal-combustion engine rigs for certain jobs.

A detailed description is given of the rig used to drill this particular well. The average fuel consumption for nine full months of drilling was 34,000 cu. ft./day. The greatest fuel consumption was during the deepest drilling and coring. Actual daily consumption during the deepest drilling exceeded at times the average for the maximum month.

Speed is not such an important factor in a test well when geological information and knowledge of subsurface conditions are the primary consideration. In another well the well was drilled to a depth of 7460 ft. in twenty-six drilling days, this time including the cementing of the surface- and water-strings. At one time 900 ft. of 12¼-in. hole was made in 6 hr.

A new draw-works is described which has six speeds forward and two reverse.

Other gas-driven rigs are described, as well as certain diesel-driven ones. Information is given of performance and characteristics of such rigs. A. H. N.

610.* Development of a Pressure Core-Barrel. Anon. *Petrol. Times*, 2.3.40, **43** (1,103), 193.—The new core-barrel is essentially a conventional core-barrel, with the addition of special valves at either end of an inner barrel and a mechanism for closing the valves while the barrel is at the bottom of the hole.

Tests have been made in five different wells, in which seventeen cores were cut, two of which were cut and sealed at the pressure and temperature prevailing at the bottom of the drill-hole. The pressures in the test-wells ranged from approximately 1000 to 2700 lb./sq. in. Although minor changes in the design of the barrel will undoubtedly be necessary to assure satisfactory operations in every respect, the tests indicate that a core-barrel patterned after the present experimental barrel will recover cores under pressure.

The analysis of one core taken with a pressure core-barrel indicates that there was a considerable amount of contamination of the core by drilling-fluid. Although a satisfactory solution of the contamination problem does not appear impossible, the factors involved present many difficulties requiring much research before cores can be taken that will be entirely satisfactory for estimating oil reserves. A. H. N.

611.* A Portable Telescoping 84-ft. Derrick. Anon. *Petrol. Times*, 16.3.40, **43** (1,105), 240–241.—Photographs and description are given of a portable 84-ft. derrick which may be used for servicing 100 wells per unit, thus eliminating the need of erecting servicing derricks.

Since the cost of 15–20 derricks pays for the unit, a saving of at least 80 derricks out of each 100 wells will be possible. A. H. N.

612.* Drilling Activity in January 1940. L. J. Logan. *Oil. Wkly*, 12.2.40, **96** (10), 12.—A decline in drilling activity shown in January was seasonal; the field work was exceptionally brisk for an initial month. Actually, drilling activity during the first month of 1940 is around the highest level ever reached in an initial month.

Tables and graphs are presented and the data are analysed and compared with previous corresponding data. A. H. N.

613.* High Pressure Mud Stream Aids in Lowering Viscosity. Anon. *Oil. Wkly*, 12.2.40, **96** (10), 41–42.—The current trend of drilling deeper and straighter holes than previous ones increases the importance of mud viscosity control. A simple method to decrease the viscosity of the mud is described.

It consists essentially of a 10- to 20-ft. length of a large-diameter casing that is placed in the mud ditch a few feet down-stream from the outlet pipe that comes from the well. A fine stream of high-pressure mud from a small auxiliary slush-pump is forced through a small nozzle at the up-stream end of the pipe, and is directed against an irregular group of six or eight small steel baffle-plates welded to the upper part of the lower end of the pipe. The resulting sprays of the mud directed into the main stream serve to agitate the mud, and thus break down its viscosity, and aid in the escape of free gas held in suspension. For extremely critical conditions the nozzle can be swung downward to point directly into the mud, and will churn it up violently. A short piece of ¾-in. pipe was experimentally found to be the best size for the nozzle.

The mud can be treated near the point where it leaves the hole, and so it is still moving fairly fast. Thus no gel formation is allowed to prevent the escape of occluded gas and small cuttings held in suspension. A. H. N.

614.* Degassing Drilling Fluid Prevents Blowouts. H. F. Simons. *Oil Gas J.*, 8.2.40, **38** (39), 43–44.—Blowouts are caused by the well-bore encountering a gas-bearing formation of a greater pressure than the hydrostatic head of the drilling-fluid. Two methods are available for preventing blowouts: the use of a preventer and the use of a mud having a high specific gravity.

Merely increasing the weight of the mud has, however, several disadvantages, such as a high loss of fluid in other formation, sticking of the pipe, etc. The gel strength has to be increased, with the consequence that the gas entrapped in the mud will be held more tenaciously. As the entrained gas increases, the weight of the drilling mud decreases—typical figures are given.

Several mechanical tests are now used to degas the mud. The vibrating screen removes some of the gas as well as the cuttings. Another method is to spray the mud 12–14 ft. in the air through jets, and the breaking down of the mud allows the gas to escape. This method is used to cool muds which have come in contact with hot salt-water formations.

Another method reduces the pressure on the mud. The apparatus consists of 24-in. pipe with inside baffles. A steam-jet on a small standpipe on the top of the inclined pipe reduces the pressure, and as the mud flows through, the baffles agitate it, as well as exposing a large area to the reduced pressure, and thus gas escapes. A. H. N.

615.* Metals in Drilling—Hard Facing Materials. W. L. Nelson. *Oil Gas J.*, 8.2.40, **38** (39), 50.—Although at least six types of hard-facing materials are used industrially, only the three hardest of these are used to any extent as the cutting-edge for oil well bits. These are:

Group 4.—Diamond substitutes. Fused tungsten carbides and certain metallic borides.
Group 5.—Crushed metallic carbides.
Group 6.—Black diamonds.

The properties of all six groups are compared, and it is seen that these three groups rank high in the properties of primary interest in facing oil-well drills—*i.e.*, in cold hardness, ability to scour, and roughness of deposit.

The customary materials for the main bodies of fishtail bits, drag-bits, etc., upon which the insert or facing material is laid, are tough, shock-resistant, low-manganese

steels, examples of which are given in a table. These steels are normalized after forging, and again after hard-facing.

A table gives the approximate composition, percentage of carbon, tungsten, chromium, manganese, nickel, and others, as well as recommended uses of thirty-two alloys under different trade names. A list of three references is appended.

A. H. N.

616.* Rotary Rig Cathead Operator Minimizes Drilling Time. H. F. Simons. *Oil Gas J.*, 8.2.40, **38** (40), 66.—In this fairly exhaustive article the duties and responsibilities of the cathead operator with regard to the safety of the other members of the drilling crew are described in detail. Practical hints are given and certain operations are detailed with a view to helping in shortening drilling time. A. H. N.

617.* Well Logging by Radioactivity. G. H. Westby and S. A. Scherbatskoy. *Oil Gas J.*, 22.2.40, **38** (41), 62–64.—Although electrical logging has been successful, there are numerous instances in which additional information would be of great value. Furthermore, the electrical properties of formations are not particularly stable; and because their measurement is rendered impossible by the presence of the casing, the use of electrical methods also is limited to uncased holes. Thus search was made for a measurable property that would be directly and permanently associated with a given rock. Radioactivity is such a property.

Radioactivity of a rock can be considered entirely unalterable; no temperature or pressure that can exist terrestrially has the slightest effect on the radioactivity of a substance. Further, the radiations emitted by radioactive materials have the ability to penetrate through iron, a circumstance which makes it easy to log cased holes by radioactivity measurements.

Without exception all substances, either terrestrial or extra terrestrial, are radioactive. It has been found that all matter has suffered some degree of contamination by radioactive substances. Radium is distributed widely in primary rocks, and has subsequently been redistributed in secondary rocks.

From measurements made on many rock specimens by laboratory investigations, and from the gamma-ray logs of wells surveyed to date, it is apparent that there are measurable differences in the amount of radioactive material contained in sedimentary rocks. This, together with the ability of the radiations to penetrate iron, is of vital importance, since it will allow the identification of formations in cased holes in old producing fields, where in the race to reach the deep-oil sand first no adequate log was kept of the formations above.

Since the amount of radioactive material in any sedimentary rock is determined chiefly by the conditions existing at the time of deposition, the radioactivity is a characteristic which may be as widespread and as determinative as any other correlatable factor. Of the sedimentary rocks, shales are usually the most highly radioactive, whilst the sandstones and the pure limestones are the least radioactive. In wells surveyed up to date the sandstones have been, in general, less radioactive than limestones; of the shales the dark-coloured shales are the most radioactive.

Typical loggings of four wells are given and compared. Detailed study of these wells is made, and also of comparative logs taken by the radioactivity method and by the conventional electric methods. It is shown in some cases that the former is more definite, and, further, it agreed better with mechanical coring taken accurately. Certain of the radioactivity logs were made with three strings of casing in the well and compared with corresponding sections of open hole in another. The agreement appears to be good. A. H. N.

618.* Progress in Metals—Applying Hard-Facing Material to Watercourse Outlets, Catheads, and Ditcher Teeth. W. L. Nelson. *Oil Gas J.*, 22.2.40, **38** (41), 72.—Many parts of equipment used in oil-fields and refineries can be given long, maintenance-free life by hard-facing. Some equipment is furnished with parts hard-faced by the original manufacturer. Such are Christmas trees and refinery-valves for handling oil and high-temperature steam, centrifugal pumps with hard-faced shaft-sleeves, rotary bits of all types, side-tracking mills, diesel-engine valves, valve-guides, injector assemblies, and gas-engine parts. A number of additional wearing parts, however,

are best hard-faced by the maintenance department or local welding-shop. Such are bit watercourse outlets, catheads, and ditching-machine teeth.

Hard-facing these machine parts results not only in long, efficient, and trouble-free service, but also when these parts are worn out they can be rehard-faced easily and at low cost.

The paper gives detailed sketches and photographs, and describes methods of hard-facing these three parts with alloys of the cobalt–chromium–tungsten type in order to obtain most favourable results. A. H. N.

619.* Drilling Time Data Reduces Costs of Drilling. H. F. Simons. *Oil Gas J.*, 29.2.40, **38** (42), 67–68.—Drilling-time information indicates to crews soft and hard streaks, proper amount of weight on the bit, correct rotary speed, best type of bit to use, and condition of the bit in the hole.

Not many drilling-rigs are equipped with instruments for recording drilling time. The method still in general use is to mark the kelly joint and log on a piece of paper the number of minutes required for each succeeding foot-mark to go through the rotary table. The logging is usually not filed, and is rarely continuous over the entire depth. It is mostly used where a change of formation is expected. Hence the method is not an ideal one.

There are two types of recorders, both of which are attached to the swivel and record its height on a time-chart. The principal difference between the two types is that one operates mechanically, the other hydraulically.

By experiment it was found that there is an optimum number of revs./min. for drilling-table to obtain the fastest drilling time. Selection of proper bit and obtaining the maximum footage out of it and other factors in economic drilling are facilitated by a study of drilling time.

A list of references is appended. A. H. N.

620. Bureau of Mines—A.P.I. Pressure Core-Barrel. (Progress Report on its Design and Development). D. B. Taliaferro and R. E. Heithecker. U.S. Bureau of Mines, Rep. of Investigations, 3481, November 1939.—Examination of core samples from subsurface formations is far more exhaustive to-day than formerly; not only is geological information sought from them, but physical characteristics and conditions are also determined and interpreted in terms of the rocks they represent; such properties include porosity, permeability, oil, and connate water contents, etc. It is pointed out that although reliable methods of studying cores have been used, such applications are more restricted when dealing with oil reservoirs at higher temperatures and pressures than normal, chiefly because core recovery from a formation under these conditions often results in loss of fluid content and a certain amount of contamination, especially by drilling-fluid. It has been rightly contended by many operators that if such obstacles could be overcome, the value of core analyses would be greatly enhanced.

With this problem in mind, the Bureau of Mines co-operating with the American Petroleum Institute have designed and constructed a pressure core-barrel to cut and seal samples of rock with their naturally inherent fluids, so that they may reach the surface intact and uncontaminated. This particular tool has now been tried out in five different oil-wells with some measure of success, although it is admitted that some minor changes in design will be necessary, especially to eliminate the drilling-fluid, apparently considered not an impossible task. Full description and illustrated details are given of this core-barrel, of the procedure to be adopted when using it, also of the method and equipment suggested for subsequent laboratory examination of the cores recovered. Reliable estimates of the quantity of available oil and gas within a reservoir leading to planning the most efficient means of their extraction are claimed to be possible with this technique, although more research and experimental work on oil-wells are foreshadowed before the pressure core-barrel is finally perfected.

H. B. M.

621. The Eykometer. A New Device for Measurement of the Yield Point of Clay Suspensions and Oil-Well Drilling Muds. A. G. Stern. U.S. Bureau of Mines, Rep. of Investigations, 3495, February 1940.—The importance of evaluating various clay

suspensions by comparative tests, as, for example, with bentonitic clay and oil-well drilling mud, by appeal to the "gel" content, is emphasized, but measurement of this property presents many practical problems. It is pointed out that of the many methods in use, that of the Stormer viscometer to determine the maximum load that can be placed on the pan without causing motion of the rotor is most widely adopted, but that reproducibility of observations is poor. The eykometer is essentially an instrument for making static measurements of the "yield value" of a mud directly; it consists of a transparent tube, to one end of which is fastened a small rubber balloon; details of its specification are given.

To determine the "yield value" or solidifying strength of a mud fluid, the sample is agitated and placed in the balloon; the apparatus is then fastened into a chamber filled with water to a definite level (predetermined to compensate for difference in density between the mud and water), and pressure increased until the fluid distorts the balloon, rise of the levelling-bulb being measured on an attached centimeter scale. The yield-strength of the mud fluid is the pressure in centimetres of water-pressure at which the rise of the levelling-bulb occurs. As effects of time and characteristics of the apparatus have all been standardized, it is claimed that, subject to observation of the precautions noted in this report, an average of six or eight observations should be reproducible to within $\pm$ 5%. H. B. M.

622. Drilling Patents. G. G. Harrington. U.S.P. 2,189,029, 2,189,030, and 2,189,031. 6.2.40. Appl. 6.12.38, 14.11.38, and 14.11.38, respectively. Reamers for oil-well drilling.

M. D. Carleton. U.S.P. 2,189,032, 6.2.40. Appl. 8.12.38. Reamer construction.

H. B. Book and R. H. Hanlin. U.S.P. 2,189,033, 6.2.40. Appl. 1.4.39. Reamer construction.

G. G. Harrington. U.S.P. 2,189,034, 6.2.40. Appl. 8.12.38. Reamer.

H. L. Squires. U.S.P. 2,189,035, 6.2.40. Appl. 8.12.38. Reamer.

K. E. Jones. U.S.P. 2,189,036, 6.2.40. Appl. 16.12.38. Reamer construction.

G. G. Harrington. U.S.P. 2,189,037, 6.2.40. Appl. 8.12.38. Reamer.

K. E. Jones. U.S.P. 2,189,038, 6.2.40. Appl. 16.12.38. Reamer.

W. L. Childs. U.S.P. 2,189,039, 6.2.40. Appl. 8.12.38. Reamer construction.

K. E. Jones. U.S.P. 2,189,040, 6.2.40. Appl. 27.12.38. Reamer construction.

L. S. Copelin. U.S.P. 2,189,057, 6.2.40. Appl. 11.12.37. A rotary core-drill having means utilizing hydraulic pressure of drilling mud for retaining and supporting the core-barrel in operative position.

L. A. Gilbert. U.S.P. 2,189,244, 6.2.40. Appl. 26.8.38. A pipe-spider with slips adjustable to grip pipe and restrain motion vertically in both directions.

E. E. Miller. U.S.P. 2,189,349, 6.2.40. Appl. 21.11.38. Mud-pump piston made of a hub to fit on a rod and rubber moulded on to hub.

G. D. Steel. U.S.P. 2,189,373, 6.2.40. Appl. 5.8.38. Safety cathead.

C. R. Dale. U.S.P. 2,189,445, 6.2.40. Appl. 11.7.39. Combination plug and dump-bailer.

H. A. Raphael. U.S.P. 2,189,552, 6.2.40. Appl. 13.10.37. Weight-indicator consisting of hydraulic gauge and a secondary cable to be fastened at both ends to main load-carrying cable and provide a loop in which the gauge is held under pressure.

J. W. Culbertson. U.S.P. 2,189,560, 6.2.40. Appl. 1.11.37. Angle marker for inclination-recording apparatus.

C. C. Brown. U.S.P. 2,189,575, 6.2.40. Appl. 26.4.34. Tubing support.

R. C. Baker. U.S.P. 2,189,697, 6.2.40. Appl. 20.3.39. Cement-retainer with slips, packer, and non-return valve.

C. E. Burt. U.S.P. 2,189,702, 6.2.40. Appl. 5.3.39. Well-cementing mechanism with retainer.

D. C. Sharp and R. M. Garrison. U.S.P. 2,189,839, 13.2.40. Appl. 29.11.35. Slush-pump piston.

D. G. Hawthorn and J. E. Owen. U.S.P. 2,189,900, 13.2.40. Appl. 18.6.38. Drill-stem circuit-tester for use in a bore-hole for measuring electrical characteristics of the earth.

J. T. Phipps. U.S.P. 2,189,923, 13.2.40. Appl. 21.6.37. Coring and drilling device.

O. T. Broyles. U.S.P. 2,189,937, 13.2.40. Appl. 22.8.38. Deep-well apparatus for tool-setting.

E. F. Raymond. U.S.P. 2,190,045, 13.2.40. Appl. 19.10.36. A jar for rotary drilling.

H. W. Huber. U.S.P. 2,190,235, 13.2.40. Appl. 22.5.39. Drilling apparatus fitted with a spudding action operatively connected with the drive-shaft and the drill-line.

A. C. Catland. U.S.P. 2,190,350, 13.2.40. Appl. 10.3.39. Reamer-cutter mounting-means.

H. N. Keener. U.S.P. 2,190,362, 13.2.40. Appl. 15.11.38. Well-casing made of welded bell and spigot joint.

R. W. Maxwell. U.S.P. 2,190,365, 13.2.40. Appl. 24.1.38. Cutter and bearing assembly having roller-cutters on ball bearing.

C. C. King. U.S.P. 2,190,407, 13.2.40. Appl. 19.12.38. Sand-pump.

F. L. Pivots. U.S.P. 2,190,434, 13.2.40. Appl. 20.9.37. Changeable-blade drag-bit.

C. E. Costello. U.S.P. 2,190,442, 13.2.40. Appl. 10.5.38. Tool useful for removing objects from wells using two packers to make a chamber in the well and means for gripping object and introducing fluid pressure into well to move object.

J. E. Le Bus. U.S.P. 2,190,547, 13.2.40. Appl. 7.5.37. A combination elevator and wrench for supporting pipe-sections.

F. Humphreys. U.S.P. 2,190,790, 20.2.40. Appl. 3.6.36. Bore-hole surveying-instrument, including two separate devices arranged to take up positions depending on the inclination and magnetic bearing of the axis of the lower end of the bore-hole, respectively, and recording means.

H. A. Whitlock. U.S.P. 2,190,854, 20.2.40. Appl. 23.7.38. Fibre rope-structure.

P. M. Moss. U.S.P. 2,190,880, 20.2.40. Appl. 21.1.38. Draw-works line-controller.

E. Davis Wilcox and J. Richardson. U.S.P. 2,190,901, 20.2.40. Appl. 13.9.38. Drill-hole apparatus adapted to carry ballast and move in hole by gravity.

G. Potapenko. U.S.P. 2,190,950, 20.2.40. Appl. 3.11.37. Apparatus for determining the inclination and direction of a hole by generating an elastic vibration and measuring its frequency.

I. Thomas. U.S.P. 2,191,000, 20.2.40. Appl. 3.5.37. Fishing-tool.

C. E. Van Stone and A. E. Johnson. U.S.P. 2,191,223, 20.2.40. Appl. 31.10.38. Hydrostatic bailer.

A. H. N.

Production.

623.* Bringing in a Difficult Blow-Out. Anon. *Oil Wkly*, 5.2.40, **96** (9), 15–17.—After one week of uncontrolled flow, a tricky blow-out in California field was put under control by an ingenious method. The well caught fire within a few minutes of the blow-out, and burnt down the rig.

The well was an old producing well, but at the time it started its uncontrolled flow, gas from an upper sand was being used to repressure a lower horizon. The shut-in pressure was 1450 lb./sq. in., but compressors were installed to force the gas at 3000 lb./sq. in. into the formation when the tubing failed and a blow-out ensued.

The well was making a large quantity of sharp sand and blowing an estimated 50–60 million cu. ft. of gas. Consequently, it cut away most of the surface equipment down to the ground.

The fire was extinguished without much trouble by utilizing steam to snuff it. Bringing in the well, however, demanded the design and placing in of a special packer. This packer is described in detail, and the various steps undertaken in bringing in the wild well after extinguishing the fire are outlined. A. H. N.

624.* Economics of Well Spacing. I. I. Gardescu. *Oik Wkly*, 5.2.40, **96** (9), 21.—Too heavy or too small a rate of withdrawal of oil from a field would result in waste of energy. The rate of production of individual wells would also affect the energy conservation value, as excessive rates of production would cause waste of energy in the area surrounding the well, although the rate of recovery for the field as a whole might not be excessive.

In addition to the loss of oil production through dissipation of reservoir energy, there would also be a loss of production, due to the trapping of oil, as a result of either geological conditions of the reservoir or through the by-pass of water or gas.

Although the subject of economics of well spacing was classified into separate sections, the paper discussed only those fields where the spacing of wells, within certain limits, did not affect the ultimate recovery of oil, and where operations were without restrictions of spacing and production.

A Gulf Coast field, familiar to the author, was used as a basis for computations. The data was based, as much as possible, on facts; but certain assumptions were made where data were insufficient or where the facts confused the issue or complicated the analysis.

The following basic data illustrate the type of problem tackled. The field was produced under varying conditions of competitive drilling and production. A part of the field was drilled to a density of 7·2 acres/well, another part to a density of less than 1 acre/well. The ultimate recovery of the first area was 1046 brl./acre-ft. of effective sand, and that of the latter part 1089, the difference between the two ultimate recoveries being only 4%.

The production record of the two acreas showed in both instances a primary flush stage during which time 700 brl./acre-ft. were produced, and a secondary stage of production during which the remaining 350 brl./acre-ft. were produced. The period of primary recovery was seven years for the first area (7·2 acres/well) and only two years for the second area. The period and rate of production of secondary recovery were the same for both areas.

Basing the problem on these data, and a few other detailed constants of the field and rate of production, computations were made of the present value of oil on the basis of 200 ft. of sand. Three main assumptions were made:—

(1) All wells had an equal initial production;
(2) all wells were drilled at the beginning of the producing life of the field;
(3) the decline of production during the primary stage was a constant percentage decline.

The paper showed the method of approach for solving the problem by actually solving it completely. The general attitude of many operators that fewer wells meant more profit might often be unjustified. A. H. N.

625.* Varying Well Conditions Individualize Lifting. B. Mills. *Oil Wkly*, 12.2.40, **96** (10), 15–19.—Production practices in the Rhodessa field are reviewed, and as this

field is characterized by a variety of methods, the paper is of general interest. Both gas-lift and pumping are being used in the field, with the former now in the lead. As the field becomes older, however, this is likely to change.

Of the 1100 producing wells in the field, more than half are still flowing naturally, about 250 wells are on gas lift, and about 110 are on the pump. Of the gas-lift wells, about 220 use valves or intermitters of various types, and about thirty are on straight gas lift. Most of the pumping wells use conventional rods and tubing. These various production systems are described.

Particulars are given in detail of the intermittent systems used in the field. One simple system has given good results in several wells. This is a two-string installation consisting principally of a time-cycle controller and two motor valves with the necessary drips and regulators; two check valves, one for the flow line and one for the casing-head outlet; one 3-in. × 1½-in. tubing head for the suspension of the inner string, and necessary fittings for well-head connections. The operation is described.

Troubles peculiar to this field, as well as those of general occurrence, are discussed and certain methods of overcoming them are outlined. A. H. N.

626.* Thorough Reconditioning of Old Leases Boosts Profits. F. B. Taylor. *Oil Wkly*, 12.2.40, **96** (10), 28.—No general formula exists to solve the problem whether wells should be worked over or not, and, if so, to what extent. The variables are so many that the answer is one of careful analysis rather than one formula. In all cases, however, the work, once undertaken, must be thorough.

To illustrate the type of variables affecting the problem, certain of them may be summarized here. A decision to clean out wells must be based on what increase might be expected in daily production in relation to cost. The ability of the wells to pay the cost of reconditioning plus a reasonable return on the invested capital must be determined beforehand.

In judging the applicability of clean-out methods, reserve remaining in the reservoir must be sufficient to excite an increase in flow into the hole. If the reservoir reserve is slight, it may be that flow volume is normal, despite partial blocking action of scale, etc., in which case a clean-out would be wasted effort. This is true in cases where pay sections are thin.

Remaining pressure within the formation is a major factor in the flow of oil into the hole, and relief of back pressure will proportionately increase the effective area through which the pressure may influence the migration. The older the field or well, and the less the pressure remaining, the more effective is the back pressure in retarding flow.

Down-time and length of effectiveness of reconditioning work are too highly variable for exact analysis. It is usually guesswork to predict the time for any clean-out operation.

The length of effectiveness varies not only the thoroughness of the work, but also the volume of remaining crude in the reservoir. In addition, loose material in the pay strata may quickly plug the formation about the hole and render the clean-out ineffective. A high chemical content of reservoir water, or high paraffin content of the crude, may each result in swift deposition of scale on the face of the pay, again limiting the period of effectiveness.

These principles are illustrated by quoting the production trends before and after clean-out operations were carried out on two leases in Oklahoma. The work is shown to have been thorough, and it has pulled the leases from their inferior rating.

Detailed descriptions of the clean-out operations are also presented. In brief, the operations consisted of pulling as much metal out of the hole as possible, shooting the wells, using an especially long sandpump to clean the well thoroughly of sand, allowing a few hours' standing, and using the sandpump again to take out last traces of sand, and reconditioning all the equipment both inside and outside the well.

Results prove the investment to be paying big dividends at this time, and the production graphs point to continued high production rates far above what would have been possible without reconditioning of the properties. It is believed that the thoroughness of the job is completely justified. A. H. N.

627.* Stress Peaks Relieved by Floating Rod String on Compressed Air. F. B. Taylor. *Oil Wkly*, 19.2.40, **96** (11), 14–17.—The mean effective load on rods during the up-

stroke is very seldom excessive, being well within stress ranges the rods are capable of handling. Instead of the ideal load curve, the mechanics of the motion produce a peak stress at some points of the cycle, which may be thousands of pounds greater than the maximum load for which the rod string was designed. Continual subjection of a string of rods to these excessive peaks of stress is a chief cause of fatigue, and hence of failure.

To relieve the rods of excessive peak stresses, engineers of one company employed the shock-absorbing power of compressed air, which is also being used successfully for this purpose on some new type pumping units that have been placed on the market. In the alleviator designed by the company the rod-string is neither directly nor rigidly connected to the beam through polish-rod and clamp. Instead, the rod-string is connected to the rod of a piston supported over compressed air, the cylinder holding the air being fixed to the end of the beam of a standard-beam pumping-rig. This leaves the rod-string mechanically independent of the beam.

A normal installation makes use of a cylinder having an inside diameter of 11 in. and an operating stroke of about 20 in. Compressed air is introduced into the cylinder below the piston, operating pressure being about 170 lb. per square inch. The energy exerted by the gas against the piston above it is sufficient to hold the piston at the upper limit of the cylinder except during periods of peak stress. The piston-rod may be said to " go through " the piston, for it extends down through the compressed air and through packing in the centre of the cylinder. The polish-rod is clamped to the piston-rod extension.

With correct pressure of air the supporting force is sufficient to keep the piston always at the top of the cylinder while the unit is not in operation. At such time the rod-string weight is less than the upward thrust of the compressed air. In operation on the down-stroke the piston remains at the top of the cylinder, but during the up-stroke the compressed air must support not only the weight of the rod-string, but also the fluid load. In this circumstance the downward pull of the rod-string, or the resistance of the rod-string plus the fluid column to be lifted, is in excess of the energy of the compressed air supporting the piston at the upper end of the cylinder. As a result, the piston is drawn down part way through the cylinder. As soon as the momentary load peak is passed, the air pressure pushes the piston back to its normal position in the top of the cylinder. Consequently the upward movement of the end of the beam is somewhat faster than the upward motion of the polish-rod during high stress phases of the stroke, this resulting in spreading out the stress peaks.

When the peak stresses of the up-swing are passed, the compressed air or gas within the cylinder is again greater than the downward pull on the polish-rod. At this point the piston is forced upward within the cylinder, exceeding the speed of the beam, increasing the stresses during this portion of the stroke in which the normal stress would be low, and completing the full stroke with the piston at the top of the cylinder. In this manner the alleviator " knocks off " the high stress peaks, distributing them into a relatively flat curve, every portion of which is within the range of stress tolerance.

Dynamometer cards indicate a reduction of as much as 28·6% of the stress range and of 10·4% in polished-rod h.p. The life of rods was longer and rod jobs markedly decreased.

Full details of the installation and its dimensions are given, together with other interesting data. A. H. N.

628.* High-Voltage Economy when Wells are Wide Spaced. W. C. Lane. *Oil Wkly.* 19.2.40, **96** (11), 20.—The wider spacing of wells as a means of reducing the cost of developing and operating oil properties has caused changes in a number of practices heretofore regarded as standard. During the 20 years electrical energy has been used for pumping oil wells, 440-volt equipment has become the standard. Under close spacing practice, used until recently, the distribution lines are short, and no difficulty has been experienced in reaching an economical number of wells without resorting to the use of excessively large cables. With wide-spacing practice this voltage may not be economical.

In more recent years another practice has come into use which presents a different problem. This is the source of power for small properties. The difficulty arises when it is impossible to locate the generating plant at the load centre, with the result that some lines are too long for economical transmission at 480 volts.

The remedy is to find a way of increasing the distribution voltage without increasing the cost of the apparatus involved. The paper discusses the economics of changing over to a higher voltage by assuming and solving certain problems.

Historically, voltage standards have gone through a number of changes. Starting with 120 volts, it was increased to the 250 range, and then settled down to the present 440 volts. It appears that the change in conditions justifies an increase to a higher voltage. A. H. N.

629.* Method of Installing Catenary Pull-rod Line. K. C. Sclater. *Petrol. Engr*, February 1940, **11** (5), 27–30.—By measuring the difference in work per stroke at the jack and at the knock-off post, it was found that the friction of the rod-line on the average installation was 20% of the rod-line weight. Roller rod-line carriers or well-constructed catenary rod-lines reduced the friction to 5% of the rod-line weight. Two adjacent leases were re-equipped with rod-lines with catenary sags, each being previously pumped from its own central bandwheel power and using conventional rod-line systems, and dynamometer charts were made of all wells before and after the new installations. A reduction in horse-power of 19·5% was obtained, despite the fact that 32% more pull-rods were used.

Formulae and eleven tables are given in detail in the paper for use in installing catenary pull-rod lines. Photographs illustrate the system.

In setting stakes for rod-line supports, a wire-line reel which attaches to the front bumper was found very convenient for field use. A. H. N.

630.* Dual-Purpose Well Salvaged for Repressuring after Blow-Out and Fire. W. A. Sawdon. *Petrol. Engr*, February 1940, **11** (5), 46.—A key-input well utilizing gas from an upper sand for repressuring a lower sand got out of control due to a blow-out which resulted in a fire. The method of snuffing off the fire and controlling the well is given.

Details are given both of the well as used normally with gas being drawn from the upper sand through the packed annular space between a casing and tubing and passing through the tubing back to the lower sand, and of the emergency manifold which was used to cap the well.

Specification and dimensions of the manifold are detailed, accompanied by a sketch. A. H. N.

631.* Acid Treatment of Sand-Well Revives Production. H. L. Flood. *Petrol. Engr*, February 1940, **11** (5), 170.—In the treatment used in the well, the Carr method was employed to pump in 1000 gal. of chemical. This process involves first filling the tubing and annular space with oil, and then displacing the oil in the tubing by the chemical by opening the casing-head and bleeding-off the oil displaced. This method provides a "cushion" of oil in the annular space that prevents the chemical from entering the annular space during the "squeeze" of the acid into the formation. After the chemical is in place ready for introduction to the formation, the casing-head is closed and the chemical pumps are used to pump water into the tubing, and thus "squeeze" the acid into the formation.

Beginning at a pressure of 500 lb./sq. in. in the tubing, the pressure was quickly increased to 1800. The pumps were shut down for 10 min., but the pressure decreased to 1500 only, indicating a tight formation. The pressure was then increased to 2200 lb./sq. in., when the acid apparently broke through, permitting the formation to take the chemical at a much faster rate than before.

The well has been watched during the few months since its treatment, and is still reported to produce substantially the same volume just subsequent to its successful treatment. A. H. N.

632.* California Well Successfully Capped and Controlled. L. P. Stockman. *Oil Gas J.*, 8.2.40, **38** (39), 36.—After running wild for 6½ days, a difficult well was put under control, after flames had been extinguished and a 6-in. pressure-operated valve using 1500 lb. pump pressure had been installed and the valve closed.

A description is given of the well equipment, the origin and extent of the damage, and of the method used to extinguish the fire and control the well.

The paper includes a detailed and dimensioned drawing of the blow-out-control manifold assembly, as well as a list of descriptions of the separate components which went into the assembly. Specifications and description of the material are also included. In principle the assembly consisted of a packer, a device to set the packer, high-pressure stuffing-box, a master gate, and accessories of pipes, etc. (Cf. abstract no. 630.)

A. H. N.

633.* Arkansas' Conservation Programme Attracts Wide Commendation. Part I. A. M. Crowell. *Oil Gas J.*, 8.2.40, **38** (39), 56.—Arkansas has made great strides in the past year in the conservation of petroleum. Use of the optimum daily rate of production as a basis for determining allowables, unit operation of oil-pools by implementation, method of allocating production to wells and leases in controlled fields, operation of a commission as an engineering body, and the acceptance of the commission's policy by the public have all attracted the attention of engineers interested in conservation projects.

In this, the first of a series of three papers, the author reviews the recent production history of the State. Extensive tables are supplied for various activities of production in Arkansas.

The second article will include a field and exploratory map of the productive area, and deal with the method of regulating operations and the allocation of production for each month, and the third will continue the discussion of allocations and show the success of the method by giving the detailed production history of the State's leading fields.

A. H. N.

634.* Engineering Practices Embodied in Arkansas' Conservation Act. A. M. Crowell. *Oil Gas J.*, 15.2.40, **38** (40), 48.—This article concludes the discussion started in the previous issue of the *Oil Gas J.*, and combines the second and third parts of the paper. The author describes how the Arkansas Oil & Gas Commission regulates practices of producers, determines the optimum rate of flow of wells, allocates the production for the various fields, reviews the recent production history of major fields, shows the success of modern conservation, and gives the various sections of the law under which the commission rulings are made.

Special study is made of a water-drive pool, a gas-drive pool, and a combination-drive pool. The importance of bottom-hole pressures and its maintenance are discussed.

The volumetric formula employed simply allows each well to void so much space in the reservoir, whether it be the production of oil or gas or both, in proportion to acreage assigned and pressure obtained.

It is the unanimous opinion of the Commission, after many hearings on the subject, that the methods used are reasonable and practical ones, and that they have prevented, and are preventing, reasonably avoidable drainage between producing tracts, obviating the drilling of unnecessary wells, and approaching as nearly as possible equity in production.

Over-production is being prevented in the wasteful building up of above-ground stocks of oil. Stocks on hand have been reduced by 30·5% since the discovery of the new reserves.

This long paper is liberally illustrated with tables, charts, and graphs.

A. H. N.

635.* Paraffin Problems in the East Texas Field. W. N. Little. *Oil Gas J.*, 29.2.40, **38** (42), 46, and *Oil Wkly*, 26.2.40, **96** (12), 23.—*Paper presented before American Petroleum Institute.* Physical properties of the crude oil in a reservoir, together with variable quantities of paraffin and asphaltic residues, affect the rate of underground flow, and the amount of oil that will be retained in the sand after all customary methods of recovery have been applied. Gas dissolved in an oil in a reservoir decreases the natural viscosity of the oil and allows it to flow more readily to the well bore, where the pressure has been reduced by the removal of fluid head. When the pressure decreases sufficiently, the gas comes out of solution and aids in removing the oil in the direction of the reduced pressure. The loss of vapour from the oil, the cooling effect of the expanding gas, as well as radiation of heat to the cooler upper formations,

are major factors causing the precipitation of paraffin residue from the oil in the tubing, flow-lines, and stock-tanks.

Some paraffin problems can be decreased by changing production practices. It is known that low rates of production encourage paraffin deposits; however, it is beyond the scope of this paper to determine the advisability of this practice. Many of the operators of the East Texas field fear the possibility of local water coning more than paraffin accumulation.

Wells that have a high flowing pressure generally operate flowing "go-devils" very satisfactorily.

Companies operating only a few wells in the field generally prefer to use chemicals to clean paraffin deposits from troublesome wells. There is less investment necessary for proper chemical treatment than for equipment needed for mechanical scraping.

When one all-purpose unit will handle all the service work of a company, elimination of the use of tubing-board and long lubricator should result in a saving. It must be remembered, however, that the use of double-stuffing-box arrangement necessitates the use of a heavy stem in high-pressure wells.

"An ounce of prevention is worth a pound of cure," is believed to apply in removing paraffin deposits. It has proved advantageous to schedule cleaning work so as to clean the deposits from the wells before the paraffin becomes thick and hard. Light equipment can perform this work very rapidly. It is not necessary to have a derrick on the location when light equipment is used for the scraping work. The lubricator used with light equipment is usually 6 or 8 ft. long, and has a combination pulley, swivel, and oil-saver on top. Companies using light equipment for paraffin-scraping work find that fewer heavier all-purpose units are needed to take care of the heavy-duty work. A. H. N.

636.* Cutler's Rule of Well Spacing. Anon. *Petrol. Times*, 2.3.40, **43** (1103), 190–192.—This paper is a summary of the Report of Investigation No. 3479, issued recently by the U.S. Bureau of Mines, embodying a comprehensive review of Cutler's tentative rule of well spacing and a re-examination of the data considered by him as combining the essential characteristic of wells in different parts of the U.S.A. to show the difference in oil recovery that may be expected from wide and from close spacing of wells.

Cutler's rule is explained, as it has been misquoted and wrongly interpreted on many occasions. The rule infers that doubling the distance between wells doubles the ultimate production per well from wells having the same initial year's production, and halves the recovery of oil from the pool; or, halving the distance between them, results in halving the ultimate production per well from wells of equal size and in doubling the recovery of oil from the pool.

An example is worked out to demonstrate that the energy required per unit of time to move oil through different distances but at equal volumetric rates to wells in a homogenous formation is not proportional to the distance through which oil moves, as Cutler assumed, because such relationship between energy and distance holds true for pipe-lines and analogous conduits. The essence of the problem is that

$$\Delta P \propto \log_e \frac{r_f}{r_s}$$

and not $\Delta P \propto r_f$ as in pipe-line problems,

where ΔP = pressure drop,

r_f = distance through which oil moves,

r_s = radius of well.

Thus in the specific problem considered doubling the value of r_f from 330 to 660 ft. meant an increase in ΔP of only 10%—*i.e.*, 20 lb./sq. in., instead of 200 lb./sq. in., which a strictly linear proportionality would demand.

As energy required per unit time to move a liquid is equal to drop in pressure in lbs./sq. ft. multiplied by the volumetric rate of liquid flowing, the increase in energy required on doubling the distance for a constant rate of flow will follow the same law as the pressure drop. In the specific example increase in energy required will therefore be 10%, and not 100% more. A. H. N.

637. Résumé of Oil-Field Operations in 1937. R. D. Bush. *Summary of Operations, California Oil-fields*, 1938 (1940), 23, 3, 5.—Production of oil in the State of California in 1937 totalled 237,459,008 brl., an increase of over 24 million brl. compared with 1936. The report gives details of the several field operations during the year under review and notes the discovery of two new fields, Rio Bravo and Canal Oil-fields, Kern County, during that period. New productive areas and deeper producing zones were discovered, notably the Rancho San Francisco area of the Newhall field, the Lomita area of the Torrance field, and the western part of the Montebello field.

H. B. M.

638.* Closing a Gas Blow-Out. V. Ya Valtsev and V. P. Timchenko, *Azerb. Neft. Khoz.*, December 1938, **18** (12), 11–13.—Account is given of a successful method of closing-in a gas blow-out at a well more than 1800 m. deep in Baku field, after previous attempts had failed. Gas pressure was 60 atm.

L. R.

639.* Drilling-pipe Back-Pressure Valve. L. I. Mirkin. *Azerb. Neft. Khoz.*, December 1938, **18** (12), 23–24.—Drawbacks of back-pressure valves generally used in the U.S.S.R. are: Complicated production of valve-seat and valve-stem guide, rapid erosion of seat and valve during use, and difficult repair.

An improved type of back-pressure valve has been developed by E. Kh. Mekhtiev, in which valve proper with valve-guide are placed freely into a suitable recess of the back-pressure-valve housing. The valve head carries a rubber ring on its upper face, and is pressed upwards by a coil spring against the face of the drilling-tube to which the valve housing is screwed. By means of the rubber ring a tight closing of the valve is ensured. The following advantages are claimed: simple production, easy fitting, better tight-holding, longer life, and easy repair.

Several back-pressure valves of Mekhtiev type have been tested in practice and given satisfactory results. One valve has been in use for 283 hrs. without repair.

L. R.

640.* Flow Characteristics of Gusher Wells. G. N. Gaziev. *Azerb. neft. Khoz.*, January 1939, **19** (1), 37–43.—The author indicates a method of approximately estimating the formation and casing-head pressure of a gusher well, and the rate of flow of oil through the reservoir rocks.

Equations are developed permitting to estimate:

(1) Gas pressure within the oil-string of a flowing well,

(2) Formation pressures using the indicator curve evolved by Marsh's and Robinson's empirical formulae, basing on three different rates of production obtained by varying the flow-bean diameter. The indicator curve obtained permits to calculate the reservoir pressure. An example is given.

(3) Potential flow of well—*i.e.*, that maximum rate of flow under which the formation pressure is still high enough to give the gas sufficient energy for a natural lift of the oil to the surface. This potential flow may be estimated from empirical plots of rate of flow against pressure necessary for migration of oil towards bottom-hole.

(4) Proportion of free gas to gas liberated from solution during lift.

(5) Apportioning consumption of energy of reservoir gas to individual points: reservoir rock, tubing, and flow-bean.

(6) Optimum diameter of tubing.

(7) Diameter of flow-bean.

L. R.

641. Production Patents. G. A. Zeidler, Jr. U.S.P. 2,188,936, 6.2.40. Appl. 22.10.37. Method of developing wells by repeated extraction of liquid and fines from well, followed by settling the fines in the vicinity of the well, and then recharging the liquid into the formation to release all loose fines from the screen and the pay-face, and starting the cycle by liquid and fines withdrawal again.

J. F. Kohnke. U.S.P. 2,189,070, 6.2.40. Appl. 3.5.38. Pipe-joint.

H. E. Driggs and H. Rauser. U.S.P. 2,189,103, 6.2.40. Appl. 10.11.38. Testing-tool for wells consisting of tubing, packer, and inlet-valve means which can be opened by vertical movement of tubing.

C. E. Bridwell. U.S.P. 2,189,129, 6.2.40. Appl. 9.3.37. A valve mechanism adapted for being interposed in a fluid conduit and controlling the flow of fluid through the conduit.

F. Wilcom and R. D. Thompson. U.S.P. 2,189,237, 6.2.40. Appl. 21.7.37. Combination cup and plunger oil-well pump fitted with scraper and valves to remove sand from barrel into a chamber and then sand to be flushed out.

M. W. Russell and P. G. Miller. U.S.P. 2,189,272, 6.2.40. Appl. 22.8.38. Sand- and gas-trap having a tube with inside baffles.

J. L. Morris. U.S.P. 2,189,350, 6.2.40. Appl. 13.11.37. Pipe coupling.

C. E. Burt and E. Graham, Jr. U.S.P. 2,189,701, 6.2.40. Appl. 21.4.39. Production-packer and liner-hanger with hydraulically tripped slips.

C. E. Burt and E. Graham, Jr. U.S.P. 2,189,703, 6.2.40. Appl. 25.7.39. Well-production apparatus comprising a packer.

C. Irons. U.S.P. 2,189,798, 2,189,799, and 2,189,800, 13.2.40. Appl. 30.12.36. All three patents deal with treating an oil well with hydrochloric acid, wherein the acid, on admixture with oil in the formation, forms a viscous mixture hindering the penetration of the acid into the formation. Small proportions of guaiacol are used in the first, of thymol in the second, and of mono-, di-, and tri- chlorophenols in the third specifications.

J. S. Fuller. U.S.P. 2,189,893, 13.2.40. Appl. 15.7.37. Pumping apparatus with means to shift the point of application of power to obtain a maximum moment arm at the time of maximum load during the upstroke of the pump mechanism and a minimum moment arm at the time of minimum load during the downstroke. Rotating balance weights are also used.

T. V. Moore. U.S.P. 2,189,919, 13.2.40. Appl. 18.7.36. Method and apparatus for formation pressure testing which comprises shutting off communication with formation of the liquid at a point above formation, opening communication of the formation to a pressure less than the formation pressure, and recording the pressures in the hole as flow occurs.

H. A. Holzer. U.S.P. 2,190,070, 13.2.40. Appl. 14.9.38. Pumping unit.

C. T. McCoy. U.S.P. 2,190,104, 13.2.40. Appl. 14.5.38. Method and means for separating oil and gas adapted to be lowered to the lower end of a well-bore.

C. P. Walker. U.S.P. 2,190,141, 13.2.40. Appl. 29.4.39. Pressure wave velocity measuring system adapted with means to vary the frequency of wave until it resonates in the medium of a tube, and means for measuring this resonance frequency.

C. E. Braden. U.S.P. 2,190,145, 13.2.40. Appl. 27.5.39. Well-hole cleaning device with expansible brush-head mounted on a reciprocating plunger.

C. E. Blackburn. U.S.P. 2,190,250, 13.2.40. Appl. 18.10.37. Apparatus for testing oil- and gas-wells.

G. H. Ennis. U.S.P. 2,190,260, 13.2.40. Appl. 21.6.36. Apparatus for determining pressure and temperature in a well by electrical circuit which translates pressure and temperature impulses on a pressure- and temperature-responsive means at the well bottom to readings at the surface.

W. T. Robertson. U.S.P. 2,190,535, 13.2.40. Appl. 20.9.38. Pump for deep oil-wells fitted with a power-piston.

L. B. Slichter. U.S.P. 2,190,686, 20.2.40. Appl. 29.1.36. Mineral exploration in a drill-hole by creating acoustic and electro-magnetic fields and measuring them at various points.

G. L. Kothny. U.S.P. 2,190,716, 20.2.40. Appl. 16.5.39. High-pressure closure in combination with a casing subjected to high external pressures.

M. O. Johnston. U.S.P. 2,190,989, 20.2.40. Appl. 13.12.37. Method of preparing an oil-well for production.

C. J. Coberly. U.S.P. 2,191,093, 20.2.40. Appl. 6.5.38. Flow-governor for fluid-operated deep-well pumps.

C. Schlumberger and A. M. L. Doll. U.S.P. 2,191,119, 20.2.40. Appl. 11.5.35. Method of, and apparatus for, surveying the formations traversed by a bore-hole by transmitting and receiving compressional waves.

L. B. Slichter. U.S.PP. 2,191,120 and 2,191,121, 20.2.40. Appl. 2.3.35. Method of geological survey in a bore-hole by utilizing sound-vibrations.

R. L. Chenault. U.S.P. 2,191,369, 20.2.40. Appl. 20.12.38. Reciprocating-fluid motor-driven pump adapted to be positioned in a well.

R. L. Chenault. U.S.P. 2,191,370, 20.2.40. Appl. 23.3.39. Apparatus for controlling fluid flow in oil-well.

J. E. Hall. U.S.P. 2,191,380, 20.2.40. Appl. 13.1.37. Well-pump which is self-washing and self-desanding. A. H. N.

Cracking.

642.* Cracking Tars and Distillates from Coal. G. Egloff, J. C. Morrell, G. B. Zimmerman and W. E. Lemen. *Industr. Engng Chem.*, 1940, **32** (1), 39.—An investigation has been carried out in a pilot-cracking plant, using coal-tars, creosote oils, lignite tar fractions, and distillates from low-temperature carbonization of coal, with the object of evaluating such materials as cracking stocks. These charging stocks may be cracked under suitable operating conditions to produce gasoline, gas and coke or fuel oil residues. Low-boiling phenols may be simultaneously produced from higher-boiling tar acids. The finished commercial products include gasoline, cresylic acid, fuel oil, domestic coke, electrode carbon and polymer gasoline. The production of tar acids may be varied within considerable limits by changing the boiling range of the whole distillates from the cracking unit.

In comparison with petroleum cracking greater plant corrosion is encountered and lower plant capacities are obtained when cracking tars and distillates from coal. The untreated gasolines are of higher specific gravity and octane number indicating the presence of aromatic hydrocarbons. Acid treatment reduces the specific gravity and octane number to a varying degree, depending on the charging stock and the treatment given. The finished gasoline from coal tar in comparison with petroleum cracked gasoline is higher in specific gravity, octane number, and has a very high oxygen bomb stability, presumably because of naturally occurring inhibitors. Sulphur reduction and removal of gum-forming constituents are difficult with these gasolines.

The gas, although produced in greater quantity than in normal petroleum cracking, is lower in density and heating value, the difference being due to a larger proportion of hydrogen and methane. By fractionation useful concentrations of the higher olefinic constituents of the gas may be obtained for further processing to gasoline by catalytic polymerization. H. E. T.

Chemistry and Physics of Petroleum.

643.* Engineering in the Service of Chemistry. T. H. Chilton. *Industr. Engng Chem.*, 1940, **32** (1), 23.—A brief description is given of some of the many applications of engineering in chemical processes. This is followed by a discussion of the laws of fluid, mass, and heat-transfer, and the methods used by chemical engineers to correlate the available data, and to predict performance in unit processes. P. D.

644.* High-Pressure Vapour-Liquid Equilibrium. E. R. Gilliland and H. W. Scheeline. *Industr. Engng Chem.*, 1940, **32** (1), 48.—Experiments were made on the system propylene–*iso*butane at pressures up to 600 lb. per sq. in. and temperatures up to 260° F. Experiments were also made on the system H_2S–propane at pressures from

400 to 600 lb. per sq. in. and temperatures up to 200° F. The results are presented in tabular and graphical form.

The vapour–liquid equilibrium obtained is compared with that predicted by equilibrium charts based on fugacity. Reasonable agreement is obtained in the case of the hydrocarbon system at pressures up to 200 lb. per sq. in., but as the critical condition is approached considerable divergences appear.

An empirical method for deriving the equilibrium constants for binary hydrocarbon mixtures at higher pressures is suggested, based on the data for such systems given in the literature. P. D.

644*a*.* Solubility of CO_2 in Benzene at Elevated Pressures. Shen-Wu Wan and B. F. Dodge. *Industr. Engng Chem.*, 1940, **32** (1), 95.—The equilibrium phase composition were determined at temperatures of 30, 40, 50, and 60° C. over the complete range of compositions. P. D.

645.* Phase Equilibria in Hydrocarbon Systems. Propane–*n*-Butane System in the Critical Region. C. N. Nysewander, B. H. Sage, and W. N. Lacey. *Industr. Engng Chem.*, 1940, **32** (1), 118.—Volumetric and equilibrium phase compositions were determined for six mixtures at temperatures above 160° F. The experiments covered the complete two-phase system. P. D.

646.* Vapour Liquid Equilibrium of the System *iso*Propyl Ether–*iso*Propanol. H. C. Miller and H. Bliss. *Industr. Engng Chem.*, 1940, **32** (1), 123.—The solvent properties of *iso*propanol and the high octane number of the ether have recently made these materials of particular interest. Data relating the vapour–liquid equilibrium of the system have been established. These data will facilitate greatly the design of separation and purification equipment. An azeotrope having the composition 78·2 mole-% *iso*propyl ether and a boiling point of 66·15° C. is shown to be formed. J. W. H.

647.* Separation Processes : The Principle of Minimum Dilution. M. R. Randall and B. Longtin. *Industr. Engng Chem.*, 1940, **32** (1), 125.—The highest thermodynamic efficiency of a process is obtained if those streams which have to be mixed are as nearly as possible in equilibrium. Graphical methods are used to demonstrate the soundness of this principle, and consideration is given to several practical cases in which the principle is not always adhered to. P. D.

648.* Physical Properties and Chemical Constitution. IV. Methyl*cyclo*hexane and the Multiplanar Structure of Methyl*cyclo*hexane. D. M. Cowan, G. H. Jeffery, and A. I. Vogel. *J. chem. Soc.*, December 1939, 1862–1865.—These authors have presented further evidence for the existence of B and B′ forms of methyl*cyclo*hexane. The A forms (vide Part III, *J. chem. Soc.*, 1938, 1323) have been shown to be impure forms of B′, but the possibility of a third isomeride is suggested.

From the results support is claimed for the view that the methyl*cyclo*hexane ring exists in multiplanar forms. E. H. W.

649. Isolation of 2 : 2-Dimethylbutane from Natural Gas and Determination of its Physical Properties. M. M. Hicks-Bruun, J. H. Bruun, and W. B. M. Faulconer. *J. Amer. chem. Soc.*, 1939, **61**, 3099–3101.—The last isomeric hexane to be isolated from natural sources was prepared in a pure form from a West Virginia natural gas, and the specific gravity, boiling point, ref. index and f.pt. were determined. The sample was observed to freeze to transparent crystals at − 98·7° and to begin to form white crystals at − 99·7°, but no definite explanation of this is offered. Except for 2 : 3-dimethylbutane, the isomer occurs to a smaller extent than the other hexanes in natural gas (168 ml./cu. m.). R. D. S.

650. Co-Ordination Complexes of Mercuric Ion with *cyclo*Hexene. H. J. Lucas, F. R. Hepner, and S. Winstein. *J. Amer. chem. Soc.*, 1939, **61**, 3102–3106.—It is reported that two rapid reactions, viz :—(1) $C_6H_{10} + Hg^{++} \rightleftharpoons C_6H_{10}Hg^{++}$ (2) $C_6H_{10} + Hg^{++} + H_2O \rightleftharpoons C_6H_{10}HgOH^+ + H^+$ occur with slower secondary reactions

taking place at the same time in the distribution of *cyclo*hexene between carbon tetrachloride and aqueous solutions containing mercuric nitrate, nitric acid, and potassium nitrate of unit ionic strength. R. D. S.

651. Vapour–Liquid Equilibrium. IV. Carbon Tetrachloride–*cyclo*Hexane Mixtures. G. Scatchard, S. E. Wood, and J. M. Mochel. *J. Amer. chem. Soc.*, 1939, **61**, 3206–3210.—The authors have measured the vapour–liquid equilibrium pressure and compositions at 40° and 70° throughout the composition range of carbon–tetrachloride–*cyclo*hexane mixtures, and at 30°, 50°, and 60° for approximately equimolar mixtures. They give also their values of the densities at 25°. These results are examined from thermodynamic considerations, and the authors notice that the unexplained entropy increase on mixing is only one-thirteenth as large as for benzene–*cyclo*hexane mixtures which they have previously reported. R. D. S.

652. Structure of Vinyl Polymers. VI. Polyvinyl Halides. C. S. Marvel, J. H. Sample, and M. F. Roy. *J. Amer. chem. Soc.*, 1939, **61**, 3241–3244.—The action of zinc on a very dilute solution of polyvinyl halide in dioxane results, under the most favourable conditions, in the removal of 84–87% halide and the production of an insoluble polymeric material which does not decolorize an alkaline solution of potassium permanganate. It appears that the polyvinyl halides have the 1 : 3-dihalide structure, as neither the chloride nor the bromide liberates iodine from a peroxide-free dioxane solution of potassium iodide. This evidence is also supported by the nature of the ultra-violet absorption curves. R. D. S.

653. Structure of Vinyl Polymers. VII. Polyacrylyl Chloride. C. S. Marvel and C. L. Levesque. *J. Amer. chem. Soc.*, 1939, **61**, 3244–3246.—The results reported here show that at least part of the units of polyacrylyl chloride are arranged in a "head-to-head, tail-to-tail" formation, a behaviour which is anomalous for the vinyl halides, as these usually form "head-to-tail" polymers. The evidence is based on the production of a polymeric bromoacrylic ester by the bromination, followed by esterification of polyacrylyl chloride: when heated with potassium iodide in acetone solution, this polymer released free iodine. R. D. S.

654. Redistribution Reaction. IV. Interchange between Triethyl-lead Chloride and Radioactive Tetraethyl-lead. G. Calingaert, H. A. Beatty, and L. Hess. *J. Amer. chem. Soc.*, 1939, **61**, 3300–3301.—When trialkyl-lead halides catalyse the redistribution reaction of tetraalkyl-lead they enter directly into the reaction, and both the alkyl and halogen groups can interchange with each other. In this paper this is shown to be so when the same alkyl group (ethyl) is present in each molecule. The authors made use of radioactive lead to indicate the course of the reaction, tetraethyl-lead being made from radium D. They found that in a solution containing equimolecular proportions of radioactive tetraethyl-lead and inert triethyl-lead chloride equilibrium was attained in less than 24 hr. R. D. S.

655. Reaction between 2 : 3-Dimethyl-1 : 4-Naphthoquinone and Phenylmagnesium Bromide. II. H. M. Crawford. *J. Amer. chem. Soc.*, 1939, **61**, 3310–3314.—There are two di-addition products resulting from the 1 : 2–1 : 2 and 1 : 2–1 : 4 addition of two molecules of phenylmagnesium bromide to one molecule of the quinone. The structures and some reactions of these two compounds are given in this paper, which also shows how a parallel series of reactions results in the same product, a benzenoid hydrocarbon, formed from both compounds. In addition, structures have been assigned to various compounds formed during the reactions. R. D. S.

656. Specific Heat of Some Ethylene Halides. W. E. Railing. *J. Amer. chem. Soc.*, 1939, **61**, 3349–3353.—In this paper are values of the heats of fusion and transition and the heat capacities of 1 : 2-dibromoethane, 1 : 2-dichloroethane, and 1 : 2-bromochloroethane measured over the range 90–320° K. Inconsistent values in these properties due to the previous thermal history of the halides are discussed with reference to the restricted rotation about the carbon–carbon bond. R. D. S.

657. Reaction of Benzene with Methyl*cyclo*butene and Methylene*cyclo*butane in the Presence of Sulphuric Acid. V. N. Ipatieff and H. Pines. *J. Amer. Chem. Soc.*, 1939, **61**, 3374–3376.—A mixture composed of methyl*cyclo*butene and methylene*cyclo*butane reacts readily with benzene in the presence of 96% sulphuric acid at 0–10° to yield (*a*) 1-methyl-1-phenyl*cyclo*butane, (*b*) *p*-di-(1′-methyl*cyclo*butyl)benzene, (*c*) tri-(1′-methyl*cyclo*butyl)benzene. Hydrogenation of (*a*) gives 1-methyl-1-*cyclo*hexyl*cyclo*butane, and the *cyclo*butyl ring in the latter compound decomposes when passed over platinized alumina at 250° to form a mixture of *tert.*-amylbenzene and 2-phenylpentane by loss of hydrogen. When a phenyl group is attached to the *cyclo*butyl ring the radical becomes very stable to sulphuric acid and nitrating mixture. R. D. S.

658. Catalytic Interaction of Acetylene and Hydrogen on Platinum. A. Farkas and R. Farkas. *J. Amer. chem. Soc.*, 1939, **61**, 3396–3401.—The phenomena discussed in this paper were examined between 70 and 150 mm. pressure and over the temperature range 20–140°. Increases of pressure of the hydrogen accelerated hydrogenation, but increase of pressure of the acetylene retarded the reaction. It was noticed that when *para*-hydrogen was used for the hydrogenation, *ortho-para* conversion was much slower than it was when the acetylene was absent, and when deuterium was used, hydrogenation at 20° proceeded at only two-thirds the rate of hydrogenation by ordinary hydrogen; also deuterium was found to hydrogenate acetylene more slowly than ethylene. The mechanism of the hydrogenation of acetylene is discussed, and the authors show that acetylene proceeds to ethane by two distinct stages, the first being the formation of ethylene; the ethylene is then only further reduced to ethane after all (or nearly all) of the hydrogen has been used up: the start of the second step is manifested by a sudden increase in the rate of hydrogenation—that is to say, ethylene is hydrogenated more rapidly than it is formed. R. D. S.

659. Addition of *N*-Haloamides to Olefins. M. S. Kharasch and H. M. Priestley. *J. Amer. chem. Soc.*, 1939, **61**, 3425–3432.—The authors have formed addition products from reactions between halosulphonamides of the type R^1SO_2NBrR and various olefins. The bromine atom in the product assumed the same position as the bromine atom in the "normal" addition of hydrogen bromide. The addition of N,N-dibromosulphonamides to olefins, however, resulted in products in which the bromine atom took up the same position as the bromine atom in the "abnormal" addition of hydrogen bromide to these compounds. R. D. S.

660. Chlorinations with Sulphuryl Chloride. II. The Peroxide-Catalyzed Reaction of Sulphuryl Chloride with Ethylenic Compounds. M. S. Kharasch and H. C. Brown. *J. Amer. chem. Soc.*, 1939, **61**, 3432–3434.—Investigations into the reaction of sulphuryl chloride with olefinic compounds show that it is catalysed by organic peroxides with the same mechanism as that proceeding in the chlorination of aliphatic hydrocarbons—viz., intermediate formation of free radicals and chlorine atoms. Ethylenic compounds which, normally, are not readily responsive to the presence of traces of peroxide can be purified to a high degree so that no reaction with sulphuryl chloride will occur, whereupon the addition of a small quantity of (*e.g.*, 0·002 mole of benzoyl) peroxide will bring about a smooth chlorination. The olefins studied in this work were *cyclo*hexene, allyl chloride, dichloroethylene, tetrachloroethylene, stilbene, and tetraphenyl ethylene; in each case the product of chlorination was the corresponding dichloride. R. D. S.

661. Ketene in the Friedel–Crafts Reaction. I. Direct Acetylation of Aromatic Hydrocarbons with Ketene. J. W. Williams and J. M. Osborn. *J. Amer. chem. Soc.*, 1939, **61**, 3438–3439.—The authors show how to improve the yield of acetophenone from ketene and benzene in the Friedel–Crafts reaction by (1) use of a considerable excess of ketene, (2) use of ketene which contains minimum amounts of ethylene and carbon monoxide, (3) operation at 0°, (4) addition of aluminium chloride in small portions, with rapid stirring, (5) use of at least 1·5 moles of aluminium chloride per mole of hydrocarbon, and (6) use of an inert diluent, as carbon disulphide. Further, they show how the reaction between ketene and naphthalene may be regulated so that α-naphthyl ketone may be obtained to the practical exclusion of the β-isomer. The

preparations of methyl β-tetrahydronaphthyl ketone and *p*-phenylacetophenone, using ketene, are also reported. R. D. S.

662. Density, Thermal Expansion, Vapour Pressure, and Refractive Index of Styrene, and the Density and Thermal Expansion of Polystyrene. W. Patnode and J. W. Schieber. *J. Amer. chem. Soc.*, 1939, **61**, 3449–3451.—Physical constants of styrene and polystyrene are given over various ranges, the results being shown mainly on graphs. The thermal behaviour of the polymer is discussed. R. D. S.

663. Thermal Data on Organic Compounds. XIX. Modern Combustion Data for some Non-Volatile Compounds Containing Carbon, Hydrogen, and Oxygen. J. W. Richardson and G. S. Parks. *J. Amer. chem. Soc.*, 1939, **61**, 3543–3546.—This is an account of an investigation of the heats of combustion of β-methylnaphthalene, phthalic anhydride, phthalic acid, anthracene, phenanthrene, stilbene, pyrene, *n*-hexadecane, cetyl alcohol, 1 : 3 : 5-triphenylbenzene, and a sample of polyisobutylene, determined in a bomb calorimeter. The original paper should be consulted for a summary of experimental and derived thermal data at 25°. R. D. S.

664. Raman Spectra of Acetylenes. II. Displacements and Depolarization Factors for Phenylacetylene and Derivatives of the Type $C_6H_5C{\equiv}R$. M. J. Murray and F. F. Cleveland. *J. Amer. chem. Soc.*, 1939, **61**, 3546–3549.—Raman frequencies and depolarization factors are reported for twelve disubstituted acetylenes. Two lines on the polarization film in the 2200 cm.$^{-1}$ region have been noticed, and it has been previously suggested that one line is due to a symmetrical vibration. The authors show, however, that both lines were depolarized to the same degree, thus disposing of the above theory, since symmetrical vibrations are, in general, strongly polarized and asymmetrical vibrations are strongly depolarized. R. D. S.

665. Cycli-Alkylation of Aromatic Compounds by the Friedel and Crafts Reaction. H. A. Bruson and J. W. Kroeger. *J. Amer. chem. Soc.*, 1940, **62**, 36–44.—The authors have shown that 1 : 4-ditertiary glycols will condense in the presence of aluminium chloride with phenols, phenol ethers, and aromatic hydrocarbons. Thus 2 : 5-dimethylhexane 2 : 5-diol and phenol give a tetramethyltetrahydronaphthol derivative.

This introduction of a new hydroaromatic cycle into the aromatic nucleus has been termed "cycli-alkylation."

Isomeric compounds to those given using aluminium chloride are formed if sulphuric acid or boron trifluoride is used as the condensing agent.

1 : 4-Dichlorides, 1 : 5-diolefines, and 2 : 2 : 5 : 5-tetraalkyltetrahydrofurans gave similar condensation products to the 1 : 4-ditertiary glycols. Thiophenols behaved differently from phenol and gave diaryl dithio ethers. Thiophene took up one hydroaromatic cycle, but benzene, naphthalene, and diphenylene oxide took up two hydroaromatic cycles. E. H. W.

666. Structure of Vinyl Polymers. VIII. Polystyrene and some of its Derivatives. C. S. Marvel and N. S. Moon. *J. Amer. chem. Soc.*, 1940, **62**, 45–59.—The preparation and peroxidic polymerization of *ortho*-bromostyrene are reported.

Poly *o*- and *p*-bromostyrenes were treated with sodium in boiling xylene solution. The polymers formed sodium derivatives, but there was no evidence of a Wurtz–Fittig reaction. This was said to indicate a 1 : 3 structure for the polymers.

A preparation of α-acetoxystyrene is described, but attempts to polymerize this and a variety of α- and β-substituted styrenes were unsuccessful. E. H. W.

667. Further Observations on the Use of Hydrogen Fluoride in Acylations and Cyclizations. L. F. Fieser and E. B. Hershberg. *J. Amer. chem. Soc.*, 1940, **62**, 49–53.—Perinaphthane and hydrindene were acetylated at room temperature in the presence of hydrogen fluoride. It was shown that naphthalene and phenanthrene could be acylated at slightly higher temperatures under pressure.

The cyclizing of *o*-(naphthylmethyl)benzoic acid with hydrogen fluoride was used in syntheses of 9-methyl- and 9-allyl-1 : 2-benzanthrene. An attempt to synthesize

1′ : 9-dimethyl-1 : 2-benzanthrene by cyclization of o-(8-methyl-2-naphthyl)benzoic acid by this method gave instead the linear isomer, which was isolated in two modifications. E. H. W.

668. Peroxide Effect in the Addition of Reagents to Unsaturated Compounds. XXIV. The Addition of Hydrogen Iodide to Propene 1-Bromopropene, Allyl Chloride, and Allyl Bromide. M. S. Kharasch, J. A. Norton, and F. R. Mayo. *J. Amer. chem. Soc.*, 1940, **62**, 881–886.—The addition of hydrogen iodide to propene, allyl chloride, and allyl bromide has been shown to give in each case only one product, thus providing strong evidence that the direction of addition of hydrogen iodide to olefines cannot be reversed.

Peroxides were shown to accelerate the action because they liberated free iodine which acts as catalyst for this addition.

Addition of hydrogen iodide to 1-bromopropene gave a mixture of one-third 1 : 1- and two-thirds 1 : 2-dihalide, these proportions being in agreement with those for hydrogen chloride and hydrogen bromide additions. E. H. W.

669. Condensations by Sodium. XV. Reactions of Disodium Compounds with Ethylidene and Methylene Chlorides. A. A. Morton and J. T. Massengale. *J. Amer. chem. Soc.*, 1940, **62**, 120–123.—Amylidene-disodium was shown to react with ethylidene chloride giving heptene-2, and with methylene chloride giving hexene-1.

With benzylidene-disodium ethylidene and methylene chlorides were shown to yield respectively methylstyrene and styrene.

Phenyl-sodium prepared from chlorobenzene was less reactive with toluene than the phenyl-sodium prepared from amyl-sodium.

The authors made unsuccessful attempts to use benzyl chloride and benzal chloride as sources of mono- and di-sodium compounds, respectively. They could discover no evidence of expected reactions between the disodium compounds and pentamethylene dibromide and benzal chloride. E. H. W.

670. Condensations by Sodium. XVI. The Formation of Decane in the Wurtz Reaction. A. A. Morton and C. M. Richardson. *J. Amer. chem. Soc.*, 1940, **62**, 123–126.—The Wurtz reaction is shown to take place in two phases : first, the formation of organosodium compounds, and secondly, their reaction with alkyl chloride, giving decane.

The presence or otherwise of free radicals is discussed. E. H. W.

671. Catalytic Hydration of Acetylene and some Alkylacetylenes. R. E. Schaad and V. N. Ipatieff. *J. Amer. chem. Soc.*, 1940, **62**, 178–180.—Acetylene and six alkylacetylenes are shown to undergo catalytic hydration when passed with steam through a heated tube containing a solid phosphoric-acid catalyst. E. H. W.

Analysis and Testing.

672.* Consideration of Methods of Testing Lubricants. G. B. Martinenghi. *Olii Minerali*, 1940, **20** (1), 1–3.—A brief consideration of the A.S.T.M. method for determination of saponifiable matter in lubricating greases is made, pointing out the inconvenience, and lack of clarity of the details of the method. The methods employed by the R. Experimental Station for Oils and Fats, Milan, are described, the method being varied according to whether the nature of the saponifiable matter is or is not known. In the former case the determination is rapidly and accurately effected volumetrically, whilst in the latter case the saponifiable material is determined by weighing the sodium soap. This method takes the possible presence of free acids into consideration. A note concerning the estimation of saponifiable matter in lubricating oil is included, and it is claimed that 0·5% of saponifiable matter can be detected. P. G.

673.* Flow Characteristics of Lime-Base Greases. J. F. T. Blott and D. L. Samuel. *Industr. Engng Chem.*, 1940, **32**, 68.—The determination of the absolute viscosities

at 25° C. of several lime-base greases in a capillary viscometer under shearing stresses up to 6000 dynes/cm.² has shown that the viscosity of the oil base is the main factor in controlling the viscosity of the grease at shearing stresses considerably greater than the yield value. Empirical measurements of the flow of these greases at high shear stresses (10^6 dynes/cm.²) confirm this observation. Approximate determinations of the shearing stress at the yield point have been made by means of a concentric-cylinder torsion viscometer, and it appears probable that the soap content of the grease controls the magnitude of the yield value. J. W. H.

674.* Viscosity Index of Lubricating Oils. E. W. Dean, A. D. Bauer, and J. H. Berglund. *Industr. Engng Chem.*, 1940, **32**, 102.—The equations on which the Dean and Davis viscosity-index scale are founded, and the Davis, Lepeyrouse, and Dean subsequent modifications, are reviewed. The present paper extends the former work at viscosities below 50 sec. Saybolt at 210° F., by experimental determination of the relationship between L and H (the basic zero and 100 V.I. constants representing viscosities at 100° F. of hypothetical oils having the same viscosities at 210° F. as the oil under examination). At the lower viscosities the authors have considered it essential to work in terms of the kinematic unit, and the new data presented cover the range of 2·0–4·2 centistokes at 210° F. With this extension the viscosity-index scale can now be applied to all ordinary lubricating oils. This extension is admittedly arbitrary, as were the constants for the higher range, but it is demonstrated that the use of the new values permits viscosity indices to be obtained for light oils which correspond closely to those of more viscous products refined by the same processes from the same stocks. Specimens of nomograms and charts facilitating the estimation of viscosity indices are given, with the address from which complete sets of the charts and tables may be obtained. J. W. H.

675.* Researches on an Absolute System of Viscosity and Viscosity Index. M. G. Hugel and M. L. Clairlois. *Ann. Off. Combust. liq.*, March–April 1939 (2), 235.—By mathematical consideration of existing viscosity equations a system is arrived at which allows the representation of all viscosity temperature curves. It is considered that the general equation of viscosity curves is

$$\eta = A\epsilon^{\frac{2{\cdot}303\,a}{T-b}}$$

and that Drucher's law is only a special case where $b = 0$. The application of the derived mathematical form is illustrated by examples which include naphthenic, paraffinic, and tar oils.

In the second part a mathematical definition of absolute viscosity index is given, and is illustrated in graphs comparing calculated and practical values. A general equation for this is also given. H. L. W.

676.* Comparison of Logarithmic Formulae Linking Viscosities Linearly with Temperature. G. Juge-Boirard. *Ann. Off. Combust liq.*, March–April 1939 (2), 253.—The author proposes the formula $\eta' = k(t + c)^a$ or $\log \eta' = \log k + a \log (t + c)$ for viscosity temperature relations. This formula is compared and contrasted mathematically with the Walther—A.S.T.M. equation. Some doubt is thrown on the value 0·8 in the latter formula, and the value given by other workers is quoted.

Values obtained experimentally with a number of liquids are compared with those calculated by the Walther and the authors' formula. Although neither of the equations is in exact agreement with the experimental values, it is shown that the formula proposed gives closer agreement than that of Walther. H. L. W.

677.* Improved Sight Gauge for A.S.T.M. Tests for Burning Quality of Kerosine Oils. F. H. N. Waite and M. M. Rhodes. *A.S.T.M. Bull.*, 1940, **102**, 19–20.—Details are given of a gauge for measurement of flame dimensions in the kerosine burning test. The gauge consists of a tapered metal box with an eyepiece at the small end, a transparent glass plate having a series of vertical and horizontal graduations at the wide end, and two vanes extending 4½ in. beyond the glass plate. The gauge is mounted

on an upright metal stand, having a friction clamp to facilitate vertical adjustment, and in operation is placed in front of the lamp with the vanes on either side of the chimney, so that the vertical shadow cast by the lamp falls exactly on a vertical line on each vane. Lateral and vertical adjustments are made to bring the scale to the proper position for measuring the dimensions of the flame. A. O.

678. Amperometric (Polarometric) Titrations. 1. Amperometric Titration of Lead with Dichromate or Chromate. I. M. Kolthoff and Yu-Djai Pan. *J. Amer. chem. Soc.*, 1939, **61**, 3402–3409.—An electrometric method of titration, called "amperometric titration" by the authors, is discussed historically, and with particular reference to the determination of lead. The current which passes between two suitable electrodes at a constant e.m.f. is measured; depending on the conditions, one or both electrodes are placed in the titration medium. The end-point is found as the point of intersection of two lines giving the change of the current before and after the equivalence point. In this work the authors show that an accurate and rapid titration of lead with dichromate or chromate can be made using the dropping mercury electrode as an indicator electrode without applying an external e.m.f., a high degree of accuracy being obtained even on a 0·001-*M* solution of lead. When barium is present in large quantities, lead can be titrated amperometrically by acidifying slightly with perchloric acid. An attempt to determine both lead and barium in one titration by fractional precipitation with potassium chromate was not successful owing to co-precipitation of barium chromate with lead chromate. R. D. S.

679.* Gum Formation in Cracked Gasolines. D. L. Yabroff and E. L. Walters. *Industr. Engng Chem.*, 1940 (32) **1**, 83.—The formation of gum during the induction period of cracked gasolines has been found to proceed according to an exponential law at elevated temperatures. The time required for a gasoline to attain a gum content of 10 mg. per 100 ml. (designated as the 10 mg. gum time) is affected by temperature and oxygen pressure in essentially the same manner as in the induction period.

The effect of temperature on the 10-mg. gum time may be expressed by the equation

$$t_g = Ae^{B/T}.$$

where t_g = 10-mg. gum time in hours.
T = absolute temperature, °F.
A, B = constants depending on the gasoline under test.

The 10-mg. gum time may therefore be extrapolated to storage conditions, and thus allow a prediction of the storage life of the gasoline. H. E. T.

See also Abstract No. 621.

Lubricants and Lubrication.

680.* Utilization of Mineral Oils for the Lubrication of Aeroplane Engines. E. Thomas. *Bull. Ass. franc. Tech. Petrol.*, 15.1.40 (1), 29.—Although castor oil has been largely replaced by mineral oils an account of its gumming tendency, it is still used to a limited extent on account of its excellent lubricating qualities. The instability of castor has led to researches for a "stabilized" castor, researches which have yet to reach a satisfactory conclusion. The author stresses the importance of thoroughly cleaning an engine when changing from castor to a mineral oil.

The difficulties in manufacturing a satisfactory mineral aviation oil are great, and it must not be thought that solvent extraction is a universal panacea. A typical refining process is outlined and the types of addition agents are enumerated. In describing the characteristics required of mineral oils, the French specification, including the Dixmiar, Damian oxidation test, is mentioned. Curves are given showing the increase in viscosity, Conradson carbon, and insolubles in petroleum ether found in a 40-hr. test of a 450-h.p. engine with and without changes of oil at intervals. A comparison is made with these results and those obtained in the air specification 1093 oxidation test. It is concluded that in the engine the introduction of extraneous

matter appears more important, and that the acidity is far removed from the 2·2 value found in the artificial ageing test. Formation of chloroform insolubles is important in the engine, whilst in the oxidation test there are none.

The deposits in the engine might be formed from the burning of oil in hot places or from incomplete combustion of the fuel. These deposits are suspended in the oil and are deposited in various places; this is shown by the analyses, which are similar to those obtained from insolubles from used oils. Tests of carbonization in the absence of air by the Damian method prove that insolubles in $CHCl_3$ do not begin to form until 340° C.—the temperature at which oils begin to crack.

Bearing corrosion can be remedied by suitable choice of bearing metals, improved cooling of the oil, and the use of corrosion inhibitors. It is concluded that the task of refiners is immense: they must satisfy specifications, the tests of which are frequently quite arbitrary, as well as ensure that the oils behave well in practice. H. L. W.

681. Hypoid Lubricants for Truck Axles. Anon. *Automotive Ind.*, 15.1.40, **82** (2), 74.—It has been found that some types of hypoid lubricant are unsatisfactory at low speeds and heavy loads. Wear tests on the Almen machine differentiate between the so-called active and mild E.P. lubricants, the former giving a much higher temperature and rate of wear.

The Chrysler Corporation now uses two classifications for hypoid lubricants, truck duty, and passenger-car duty. An outline of the testing procedure used by the above Corporation is given, and it is concluded that two sets of hypoid lubricants will become general: the truck duty, a non-active (to copper) product, and the generally accepted active passenger-car lubricant. H. L. W.

682. Cutting Fluids. J. Geschelin. *Automotive Ind.*, 15.10.39, **81** (8), 424.—An Independent Research Committee on cutting fluids has been formed with the object of studying the use of cutting oils and to give reports of use to production men and users. Some simplification can be achieved by limiting the number of types used in a given shop to a minimum. An example is the Spicer Co., who use only one grade of soluble and neat cutting-oil, with the small exception of a special oil for the Gleasons. Central supply systems aid in this simplification, but where fine grinding is required, filters may be necessary.

It is safe to say that many improvements in machinery have been due to the availability of suitable cutting-fluids. An outline is given of the general requirements of cutting-fluids and of the types available. New developments—*e.g.*, sulphurized soluble oils—are mentioned; whilst an interesting example of use of neat cutting-oil with special wheels for grinding is given. The elimination of occupational diseases by keeping the cutting-fluid clean and use of suitable antiseptic is stressed.

A bibliography on cutting-fluids is given as well as the names of the chief suppliers (American) and the grades and types they market. H. L. W.

683.* Characteristics Proposed by the R. Experimental Station for Oils and Fats, Milan. Anon. *Olii Minerali*, 1939, **19** (11–12), 156–158, 168–172.—The specifications proposed by the R. Experimental Station in agreement with the Chemical Products Manufacturers' Federation, covering all petroleum products for the Italian market, are listed. P. G.

Asphalt and Bitumen.

684.* Flow Properties of Asphalts and their Measurement by the Penetrometer. C. Mack. *J. Soc. Chem. Ind.*, 1939, **58**, 306–310.—Since asphalts are sols of asphaltenes in a mixture of asphaltic resins and oily constituents, this solubility determines their flow properties, which are defined by either viscous or plastic flow, thixotropy, and elasticity. After discussion of previous work on the problem, the author shows that plotting the logarithm of penetration against the logarithm of time gives a straight line, and thus the depth of penetration can be expressed as a function of time. One constant, "c," of this equation is found to be constant (0·54) for viscous flow, but not for plastic flow. By expressing the viscosity of a plastic asphalt as a function of the rate of shear, it was deduced that "c" served as a numerical value for the flow properties of these asphalts. It is very difficult to determine the yield value from the

logarithm of the rate of penetration and the logarithm of penetration, since the necessary penetrations are usually outside the range of the penetrometer needle. If the asphalt has a definite yield value it will not flow from a penetration-can placed on edge. Most paving-asphalts, irrespective of their flow properties, have no yield value. The difference in the value of "c," when the penetration is taken before and after ageing, expresses the degree of thixotropy, if present. The determination of the elasticity by means of the "c" value of successive penetrations is mainly qualitative. A knowledge of the value of "c" also gives a complete picture of the flow properties, and ductility measurements then become unnecessary, and with its aid the consistency of asphalts can be expressed as the time required for a given penetration. It is pointed out that the viscosity/temperature coefficient remains fairly constant for a viscous asphalt, but for a plastic asphalt increases with decreasing temperature. H. G. W.

685.* Report of the Institution for Experimental Work on Roads of the C.T.I. and R.A.C.I. for 1939. R. Ariano. *Le Strade*, 1940, **22** (1), Ricerche Studi, 3–20.—The activities of the above laboratory during 1939 and conclusions reached therefrom are described.

Asphalts and Asphalt Emulsions.—The relationship between penetration and softening point was confirmed, and was found to be the same for asphaltic bitumen after emulsification. Ductility, on the other hand, does not show any relationship to these properties, and was found to be reduced on solution of asphaltic bitumen. Ductility was also found to be dependent on the paraffin content of the bitumen. It is suggested that some other test should replace the ductility test for natural asphalts or asphalts containing fillers.

Asphaltic bitumens recovered from emulsion were generally found to have penetrations higher than 150.

Asphalt Powder.—The determination of paraffin content of the extracted bitumen by the method at present used in Italy was not possible in many cases, owing to the high sulphur content. Adhesion of the extracted bitumen to stone was very good, and was believed to be probably better than for petroleum bitumen. Asphaltene determinations are made on the extracted bitumens, since this, together with sulphur content and granulometric examination, is a guide to the source of the rock-asphalt.

An attempt was made to reduce the time required to determine the bitumen content of asphalt powder, from 7 days to 24 hr., by using different containers for sedimentation.

Asphaltic and Tar Oils.—The distillation test, which is at present the principal test for these oils, gives comparative results only. An attempt was made to improve this test by substituting an electric heater instead of gas flame, or by employing the A.S.T.M. method, and results are compared. The necessity for replacing this test by some other more accurate method in order to obtain better reproducibility is pointed out.

Adhesion Tests.—Although recently adopted, using a device to measure the adhesion of binders to stone when undergoing a stress direct and normal to the contact surface, the test appears to give results corresponding to behaviour in actual service. Emulsifying agents increase the adhesion to stone of bitumen from emulsions, but the bitumen is more readily affected by water. Special precautions are necessary in testing the adhesion of oil–asphalt powder mixtures. P. G.

686.* Tar Emulsions. A. Di Renzo. *Le Strade*, 1940, **22** (1), 4–13.—The author briefly reviews the development and manufacture of tar emulsions and considers the properties of emulsions produced in Italy and other countries. Emulsions of tar-asphaltic bitumen mixtures, prepared with 1·3–2% of fatty acids, wool fat, fish oil, or coconut fat derivatives, are more frequently used than emulsions of tar alone. Methods of manufacture are briefly described and specifications for various grades of tar given. The specifications and methods of testing issued by the B.S.I. in the United Kingdom and by the D.I.N. in Germany are compared with those employed by the laboratory of the Milan municipality. P. G.

687.* Use of Asphalt Rock Powder in Liquid Mixtures. A. Berti. *Le Strade*, 1940, **22** (2), 53–60.—The first experimental application of liquid mixtures of asphaltic

rock-dusts for surface treatments, using tar-oil and regular tar as vehicle, are described.

The experiments made to ascertain the behaviour of the compounded binders with regard to traffic and inherent road conditions were carried out on two roads of intense traffic.

The condition of the roads at the time of application, materials employed, treating temperatures, and treatments are described. The organization of the experimental work and a detailed summary of materials, labour, and costs are included.

In conclusion, it is stated that the described type of road-paving is superior to that obtained with tar-emulsions, and that it compares favourably even with asphalt pavings. P. G.

688.* Evaluation of Fillers for Tar and other Bituminous Surfacings. J. G. Mitchell and A. R. Lee. *J. Soc. chem. Ind.*, 1939, **58**, 299–306.—It is pointed out that fillers have been used for some considerable time, but specifications are still generally ambiguous, and this paper shows how the choice and use of the filler can be placed on a quantitative basis. From a review of the previous literature it was concluded that little or no quantitative use could be made of the detailed grading analysis of a filler with respect to the mechanical properties of a bituminous road mixture. It is now shown, however, that the bulk density of a filler which has been allowed to settle in benzene or other suitable liquid under standardized conditions gives a quantitative measure for proportioning it as a constituent of a bituminous surfacing. It is pointed out that differences between the properties of different fillers of the same kind may be as great as the differences between different types of fillers. To measure the bulk density, the filler is suspended in the given liquid, boiled while being stirred with a copper rod to facilitate escape of air and then allowed to settle. After 24 hr. it is gently disturbed with a wire to reduce segregation. The bulk density is a result of the wetting properties of the liquid, and the grading and geometrical properties of the filler particles, each of which is apparently surrounded by an envelope of liquid. From investigations of the colour change of tar solutions before and after contact with fillers, it was concluded that the latter adsorbed certain of the tar constituents from solution, limestone and slate being most effective. These constituents appear to be mainly resinous, and the adsorption is a second-order effect. Adding filler to tar gives an increase in viscosity, but different fillers give different results. It has been shown experimentally, however, that the addition of the same bulk volume of different fillers (measured by settling in benzene) produces the same change in the viscosity of the binder. The mechanical properties of filler-binder mixtures show that there is an optimum filler-binder ratio to give a strong ductile material for each filler, and it has been shown that this optimum ratio for a given binder is proportional to the bulk densities of the fillers. It has also been shown that for any sand-filler–binder mix which contains its optimum binder content a minimum quantity of filler must be present to give maximum resistance to deformation. This quantity is determined simply by the bulk density and voids in the sand. Full-scale road experiments have shown that this bulk density is its most significant property, and that failure may easily occur through neglect to adjust the filler–binder ratio on this basis. The general conclusion is that existing specifications should contain a clause defining the relation between the bulk density of the filler and the binder content (tars and asphaltic bitumens). H. G. W.

Detonation and Engines.

689.* Tests on a Medium-compression Two-stroke Injection Engine. R. Düll and F. Zahren. *Automobil. Zeit.*, September 10, 1939, pp. 482–484.—The engine was a two-litre, single-cylinder, crankcase scavenge pump-engine with inlet ports and two exhaust-valves. The exhaust-valves were on opposite sides of the conical combustion space, with two sparking-plugs in between them. The injection-valve was in the centre of the head, and the inlet ports were arranged tangentially to induce swirl. The stroke/bore ratio was 1·91. Tests with a compression ratio of 6·2 showed that either petrol, benzol, or heavy oil could be used. With petrol or benzol, air regulation and external ignition had to be employed for part-load running, but with heavy oil, compression ignition took place without air regulation at all loads, although idling was not satisfactory. There was no knocking if the injection timing was adjusted correctly.

Spark ignition was generally necessary for starting. Further tests were made with heavy oil using compression ratios of 7·2 and 7·8, at speeds up to 1600 r.p.m., the mean piston speed then being 2200 ft. per min. The effect of exhaust pipe-length on power and fuel consumption was considerable at certain speeds, due to vibrations of the column of exhaust gas. This could be overcome by a pipe fixed in front of the intake-valve of the scavenge-pump, which had the effect of raising the volumetric efficiency. Under these conditions the load could be increased until the m.e.p. was 85 lb./sq. in. The maximum power developed was 36 b.h.p. at 1500 r.p.m. with a full-load fuel consumption of 0·49 lb./b.h.p.-hr. at speeds over 800 r.p.m. There was no knocking, in spite of a very rapid pressure rise to a maximum pressure of 850 lb./sq. in. The injection point varied with speed between 25° and 50° before t.d.c., and must be carefully controlled. Good slow running could only be obtained with the exhaust-valve opening 100° before b.d.c. and closing at b.d.c., and a compression ratio of 9·3. Good running at 250 r.p.m. was then obtained. H. R. M.

690.* Steam Turbines for Motor Vehicles. Anon. *Automobil. Zeit.*, September 10, 1939, pp. 485–486.—The Hüttner (German) rotary boiler turbine consists of a ring of **U**-tubes with radial arms. One arm of each tube opens into a collecting-ring containing water, whilst the other connects to a ring-shaped steam chamber. The arms on the steam-chamber side are heated by burners, and the steam generated passes through a ring of jets and impinges on the blades of a turbine disc. The reaction drives the boiler in the opposite direction to the turbine, and the action of the centrifugal force on the water compresses the steam until equilibrium is reached. After passing through the turbine, which may have several stages, the steam is condensed and again collects in the **U**-tubes.

If the feed-water is used in the condenser, it is preheated in its passage through the turbine to the boiler. Tests on a small model showed that the 0·077 lb. water which it contained was evaporated 700 times an hour. When idling, the pressure was 13 lb./sq. in. and the boiler speed 2,800 r.p.m., whilst at full load the pressure was 73 lb./sq. in., the boiler speed 5000 r.p.m., and the turbine speed 17,000 r.p.m. The boiler efficiency was 80% throughout the load range. For starting, the boiler must be turned at 1/10 the full-load speed. The starting time is 10 sec. The design of a multi-stage 100-kW. turbine is shown.

The Béchard (French) boiler consists of three or six hollow discs joined by short tubes, enclosing a shaft on which are mounted a similar number of thin discs which divide the hollow discs into two spaces. The feed-water enters the space at one end through the shaft, and the whole boiler is heated by gas or oil-burners. The steam passes out of the end of the boiler opposite to the feed through a ring of jets, and its reaction against the blades of a fixed turbine disc rotates the boiler. When the boiler has been running long enough to reach equilibrium, the water is heated in the first hollow disc, evaporated in the second, and superheated in the third. The feed-water and the burner are regulated according to the load. Tests on a boiler holding 0·21 cu. ft. of water showed that with a pressure of 440 lb./sq. in 50 h.p. was developed at a speed of 1800 r.p.m.

The Besler (American) boiler consists of a single spiral tube of Inconel. Water is fed in one end by a high-pressure pump, and leaves the other end in the form of superheated steam at 400° C. and 1300 lb./sq. in. pressure. It is heated by a thermostatically controlled oil-burner which is turned out if the steam exceeds the specified temperature and pressure, and electrically ignited when the pressure falls again. Trials on a boiler, coupled to a 600-h.p., 2-cylinder compound railway engine, showed that it took 4 min. to heat up before starting. H. R. M.

691.* Water Injection in Petrol and Hot-bulb Engines. W. Riedel. *Automobil. Zeit.*, January 25, 1940, pp. 25–35.—A Mercedes 1·7-litre car was driven at 90 km./hr. with varying amounts of cold water drawn in at the carburetter venturi. With small quantities no effect was observed, but fuel consumption increased when the volume of water exceeded 25% that of the fuel. Similar results were obtained in a 1·7 Adler Trumpf engine on the bench with a consistent increase in fuel consumption and decrease in output with increasing addition of cold water.

In another test, steam was introduced between the air-cleaner and carburetter of the Adler Trumpf engine. The adverse effect of steam was considerably greater than

that of cold water. The reduction in power was mainly due to the displacement of part of the intake air by steam.

In Lanz two-stroke hot-bulb tractor engines operating on heavy fuels, water is added at the orifice of the open nozzle in order to eliminate knock and deposits. With an engine of 225- and 260- mm. bore and stroke, 6·9 : 1 C.R., running at 630 r.p.m. and developing 20 b.h.p., injection of 21·7% water reduced the wall temperature of the hot-bulb from 800 to 520° C., with 15% decrease in fuel consumption. With a C.R. of 10·75, at 630 r.p.m., the power output was limited to 32 h.p., due to knock, but could be raised to 48 h.p. when water was injected. L. R.

692.* Fuel Consumption (Extracted from Year Book of German Aeronautical Research. Air Ministry translation No. 945). F. A. F. Schmidt. *Auto. Engr*, 1940, **30**, No. 393, 20–22.—(1) *Theoretical Possibilities of Improving Fuel Consumptions.*—The possibility of improving fuel consumption by increase of compression ratio depends on the nature of the fuel utilized, as the upper limit to the compression ratio is governed by the phenomena of detonation and pre-ignition. Data are given showing the theoretical consumption and MEP as a function of the compression ratio calculated from data by Kuhl. It is clear that fuel economy can only be obtained by using weak mixtures at high compression ratios.

(2) *Improvement of the Relative Efficiency of Weak Mixtures by Early Ignition and Employment of Multiple Sparks.*—Curves are given showing the effect of ignition timing on power with excess air; the effect of excess air on power and consumption; the effect of multiple sparks with one or more plugs on power and consumption at varying mixture strengths.

The principal reason for drop in relative efficiency with weak mixtures is bad distribution. Suitable carburettor installation may improve matters to some extent, and further improvements are obtained if multiple sparks are employed. A combination of two plugs, one normal, and a second provided with series sparks, gave constant specific consumption over a range of weak mixtures; minimum consumption (with no misfiring) was obtained with 20% excess air.

(3) *Increase in Performance by Valve Overlap Accompanied by Supercharging.*—Data are presented showing the relation between boost pressure on consumption and IMEP. If appreciable valve overlap exists, it is possible to increase the charge weight still further by scavenging the clearance volume, and so increase power. Curves illustrating this and the influence of valve overlap on air consumption at varying speeds are given. C. H. S.

693.* Engine Combustion and Pressure Development. G. M. Rassweiler, L. Withrow, and W. Cornelius. *J. Soc. Aut. Engrs*, 1940, **46** (1), 25–48.—In an earlier paper (see Abstract No. 1177, 1938) the authors discussed methods for determining from the pressure-card the amount of charge that is burned at any time during an engine explosion. The study has been extended to various operating conditions, utilizing high-speed motion pictures of the flames, together with pressure records of the same explosions. The photographs show that the flame envelopes were generally not spherical in shape, and were more " ragged " with weak mixtures. Shifting the ignition point from the side to the centre of the combustion space advanced the time at which combustion ended and maximum pressure occurred; the maximum pressure also was increased. At part throttle the centre of volume of the inflamed charge was frequently at some distance from the spark gap. This is attributed to mass movements of the charge.

Some quantitative relationships between the fraction of charge burned and the pressure developed at any time during the explosion have been correlated with the experimental data obtained under various operating conditions. It is shown that the fractional volume and fractional mass of charge inflamed at any time may be calculated from the pressure-cards with an accuracy comparable with that of the experimental observations. K. A.

Economics and Statistics.

694. Petroleum Refineries, Including Cracking Plants, in the United States, January 1, 1939. G. R. Hopkins and E. W. Cochrane. U.S. Bureau of Mines, Information Circular 7091, October 1939.—While the number of completed refineries in the United

States declined in 1938, crude oil capacity materially increased, the figure on January 1, 1939, being 4,508,555 brl. Daily average crude runs in 1938 were 3,192,000 brl. Capacity of cracking units increased in 1938, and on January 1, 1939, was 877,347 brl. during 1938 the daily average production of cracked gasoline was 714,000 brl.; the Texas Gulf Coast showed the largest gain in active cracked gasoline capacity.

H. B. M.

695.* Report of the Department of Petroleum and Hydrocarbons, Venezuela. Minister of the Exchequer. *Revista de Fomento de Venezuela*, Special number, January to June 1939.—It has been decided to suspend the granting of new concessions for exploiting mineral-oil deposits, whilst the Government will study the geological and geophysical character of various zones which are expected to be petroleum-bearing. The ultimate aim of these investigations is to enable the Government to secure more profitable terms from future concessionaires. At the same time a more active refinery policy is being pursued. A contract has been signed with the Standard Oil Co. of Venezuela to build immediately a refinery capable of dealing with 2385 cubic metres of crude petroleum daily. Another concern,—the Caribbean Petroleum Co.—in association with the Venezuela Oil Development Co., has completed extensions at San Lorenzo, which will add 1600 cubic metres daily to the capacity of their existing refinery. A considerable number of concessions have been invalidated for a number of different reasons, and these will be brought in under the new scheme. There is to be a tightening up of the regulations permitting duty-free importation of certain articles by the exploiting companies.

H. I. L.

696.* Economic Aspects of Exploitation of Petroleum in Colombia E. Ospina Racines, *Revista de Fomento* (*Venezuela*), October 1939, **11** (17), 108–119.—Colombia, is from the geological, economic, and political standpoints, in a very favourable position for developing its output of petroleum. It now stands seventh on the list of world producers. In 1937 production amounted to 20,298,000 brl., whilst their home consumption was only 2,453,000 brl. The bed of the Magdalena River is at present the only producing area, whilst the bed of the Catatumbo is in active development and indicates a deposit of major importance. There are three other areas susceptible of development. Income is derived from royalties on oil exported and from taxes.

H. I. L.

BOOK REVIEWS

Finding and Producing Oil. Pp. 338. Prepared by Division of Production, American Petroleum Institute, Dallas, Texas. 1939. Price $2.00.

The American Petroleum Institute has rendered a great service to the Petroleum Industry by the publication of its first edition of "Finding and Producing Oil," a well-conceived and excellently produced volume, adequately provided with diagrams and plates.

One of its main objects is to indicate the vast amount of available literature on the subject. The reader is able to select a subject, study it through the media of the literature mentioned, and then (if need be) consult the firms intimately concerned with the operations of that particular section, without the necessity for consulting any other publications. In spite of omissions, a well-balanced bibliography has resulted. The promise to augment and revise various sections is to be applauded.

The publication is divided into fifteen sections, six of which are concerned with the finding and production of oil. These cover such operations as Geological Methods of Oil Exploration; Geophysical Methods; Methods of Drilling; Sampling, Coring and Bore-hole Surveying; Production Methods; Measuring, Sampling, and Testing Oil Products. These sections are sub-divided to deal with the necessary individual operations.

The remaining sections deal with such subjects as Voluntary Co-operative Activities; Vocational and Scholastic Training; Oil and Gas Conservation Laws; Producers of Oil; Drilling Contractors, etc. A number of these sections are of interest only to operators of the United States of America, but this fact in no way detracts from the value of the publication.

Little can be said of the subject-matter of the various sub-sections except that sufficient is quoted to explain the titles. The authors have done their work well, and are to be congratulated on having condensed their subject-matter to readable proportions without loss of explicitness.

"Finding and Producing Oil" should appeal to all interested in Petroleum Technology, and can be confidently recommended. L. V. W. CLARK.

De La Carbonization Aux Carburants D'Aviation. Tome II. La Cokerie et l'Usine à Gas Modernes. By Charles Berthelot. Preface by G. Claude. Pp. xx + 514, with 182 figures in text. Published by Dunod, 92 Rue Bonaparte, Paris, 1940.

This is the second volume of three by the same author on the subject of "From Carbonization to Aviation Spirits." Volume I of the series dealt with the subject of Petrol and its substitutes, and has been reviewed in the July, 1939, and March, 1940 numbers of this *Journal*.

The volume under review is devoted entirely to coke-ovens and modern gas-works, whilst Volume 3, which is in preparation, will deal with carbonization as a means of gas production and with the utilization of coke-oven gases as a source of synthetic chemical products. The book is divided into fifteen sections, each of which is sub-divided, and a useful summary and conclusion are included in each sub-section. It is only possible to mention a few of the topics discussed in the book. The author begins with a review of the methods of preparing and blending coal for carbonization at low and at high temperatures, including coal-cleaning and washing plants.

A description is given of the modern coke-ovens in operation in different countries for the production of metallurgical coke. The author states that the most up-to-date are to be found in the Ruhr, in Belgium, in Holland, and in England. A whole chapter is devoted to the development of the coke-ovens in the Ruhr in October 1938. The industrial application of coke-oven gas in Germany is described, including its use in the Fischer-Tropsch synthetic process for the production of

liquid motor fuels and of soap by saponification of the fatty acids derived from the wax.

The modern coke-ovens of Germany, Holland, Belgium, and England are described in detail, including dimensions, costs and yields of coke, gas, and by-products.

Technical details are given of the heat balance of coke-ovens and the quantity of heat required for the carbonization of coal.

Other sections of the book deal with refractory materials and the many other items required in the construction of coke-ovens, including the machines for charging and discharging and the instruments for recording temperatures and gas pressures.

Since the use of gas producers enables low-quality fuels to be utilized for heating modern coke-ovens, a description is given of a number of different kinds of gas-producers used in the industry.

The recovery of tar (and of tar fog), and of numerous by-products, is treated in some detail. There is a short survey of the modern methods of tar distillation and refining for the production of pure products such as naphthalene, etc. The manufacture of sulphate of ammonia is briefly described.

In view of the increasing attention it is now receiving, about one-seventh of the whole book is devoted to modern methods of benzol recovery and its purification.

The principal methods for the recovery of elemental sulphur from coke-oven gases are described, and it is stated that in 1937 Germany obtained 120,000 tons of sulphur in this way from coke-oven gas, corresponding to about 500,000 tons of sulphuric acid.

The treatment of the effluents to render them innocuous is not overlooked.

The preparation of the coke for domestic and other markets, including the semi-coke (Carbolux) produced at les Mines de Bruay by the medium-temperature carbonization of coal, is fully described. A part of the book deals with the Woodhall-Duckham and Glover-West continuous vertical ovens and steam injection, about which the author appears to be well informed from first-hand information.

A description of the Otto horizontal chamber-type of coke-oven as used in the gas-works of Rotterdam is also included.

In a short chapter, Monsieur Berthelot discusses ways and means of eliminating the poisonous carbon monoxide from town's gas, resulting from the addition of water gas.

The book concludes with an urgent plea from the author for the modernization of the coking industries, and for more and more economy in both the construction and operation of coke-ovens—an economy which, he says, can only be acquired by the application of science and ceaseless research.

Like its predecessor, the volume under review is well printed in clear type, written in an interesting style, and is remarkably free from mistakes. There is a comprehensive table of contents at the end. The addition of an index would have enhanced the value of the book as a work of reference. W. H. CADMAN.

BOOK RECEIVED

1939 Book of A.S.T.M. Standards. Part II. Pp. xxvii + 1217. **Part III.** Pp. xx + 1175. American Society for Testing Materials, 260, South Broad Street, Philadelphia, Pa. Price $15 for any two parts.

The Book of A.S.T.M. Standards is now issued in three parts, of which Parts II and III are of particular interest to the petroleum industry, since the former includes methods of testing and specifications of bituminous road, waterproofing, and roofing materials, whilst the latter includes methods of testing petroleum products and specifications for fuel oils, gasoline, Stoddard solvent, and petroleum spirit. Methods of testing and specifications which have been adopted as standard appear in the front of each part, whilst tentative standards are at the end. A number of revisions have been made, and while many are of a minor character or of an editorial nature, the following should be noted.

In the ductility test the period of cooling of the specimen in air prior to immersion in the water-bath is now specified as 30 min. Changes have been made in connection with the ventilation of the loss on heating oven.

In the Reid vapour-pressure test it is now specified that the internal chamber of the connection between the air-chamber and the pressure-gauge and of the passage-way from the Bourdon tube, of the pressure-gauge, to atmosphere shall not be less than 3/16 in.

The use of any form of capillary-tube viscometer for determination of kinematic viscosity is now permitted, provided the apparatus is capable of measuring viscosity with an error not greater than 0·2%. Pure distilled water has been adopted as the primary viscosity standard, but oil samples obtainable from the A.P.I. or National Bureau of Standards may be used as secondary standards.

In the kerosine burning test it is now specified that any change in the dimensions of the flame at the end of the test shall be recorded. Any deposit on the chimney shall be reported as light, medium, or heavy, and the colour of the deposit described. The tensile strength of the wick fibre as determined by pulling the charred portion with the fingers shall be qualitatively expressed as uninjured, weakened, or destroyed.

The Low-Cloud and Pour-Point thermometer is now calibrated for 3-in. instead of 4½-in. immersion.

In addition to the above revisions, three new tentative methods of test are included; these are the Test for Carbon Residue by the Ramsbottom method, Test for Gum Stability of Gasoline and Test for Tetraethyl Lead in Gasoline. A. O.

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Geology and Development.

697.* Devonian Development Forces Illinois Production Upwards. H. F. Simons. *Oil Gas J.*, 8.2.40, **38** (39), 16–17.—In the Salem field a 7380-brl. and a 10,000-brl. producer have been completed. These wells are high on the Devonian structure, which apparently follows closely the structure of the overlying Chester and McClosky. Twenty-five Devonian wells have now been drilled at Salem. The average depth of the top of the Devonian lime is 3342 ft., with the pay section 52 ft. lower. The thickness of the pay averages 46 ft. All wells are acid treated. The gas–oil ratio is high, and pressures of 1000 lb./in.^{2} have been recorded.

The McClosky lime production has declined sharply during the past year, and new completions give only about one-tenth of the output of the early ones, due to loss of pressure. The Devonian wells decline rapidly. Wells are also completed in the Benoist or Aux Vases, or in both. G. D. H.

698.* Widespread Activity is Planned in Ellinwood District in 1940. D. Dalrymple. *Oil Gas J.*, 8.2.40, **38** (39), 18, 19, 24.—The Isern pool was opened in 1930 6 ml. southeast of Ellinwood town. Then came Steckel, which combined with Isern to become Silica. This pool extended westwards, and other pools were opened in the Ellinwood district—Ellinwood and Peter. The three pools became one in 1939, on the completion of producing wells in the intermediate areas, and the total productive area was then 21,480 acres. Production is from the Arbuckle lime.

In 1939 two new pools—Marchand and West Marchand—were discovered in the Ellinwood district.

The potentials and allowables for the Ellinwood district are given.

Many dry holes have been drilled in the Ellinwood district, but they are often surrounded by producers. The pay sands are 3200–3350 ft. deep, with the initial well

potentials ranging from 100 to as much as 4000 brl. Drilling conditions are generally favourable. Water disposal is a problem. G. D. H.

699.* Mississippi Soon to Have Thirty-Seven Wildcat Tests. G. Weber. *Oil Gas J.*, 15.2.40, **38** (40), 20–21.—At the time of the discovery of Tinsley 3,500,000 acres were leased in Mississippi, but the figure has now been doubled. 2,000,000 acres have been leased in Alabama. Seventy geophysical crews have been at work.

The eighteen Tinsley wells give 5091 brl./day, their potential being 22,500 brl./day. Artificial lift will soon be required in several of the low-pressure wells. Faulting and the lenticular character of the producing zone hamper correlation, so that very little is known of the form of the Tinsley structure. There may be several sand bodies.

A show of oil and gas has been found in a recent well in the old Amory gas-field of North-east Mississippi.

In the vicinity of Tinsley are numerous wildcats. A map shows the location of the current and proposed wildcats throughout Mississippi. G. D. H.

700.* Storms Field is Extended in South-eastern Illinois. H. F. Simons. *Oil Gas J.*, 15.2.40, **38** (40), 31–32.—Eight new fields have been discovered in White County in eight months. Of these Storm is the most interesting, with nineteen oil wells, four gas wells, and four dry holes. The average initial yield of the oil wells is 288 brl./day and 16,000,000 cu. ft. of gas. The gas wells average 7,000,000 cu. ft./day. The discovery well was a gasser. Oil comes from the Waltersburg sand in the upper part of the Chester series at an average depth of 2247–2268 ft. The oil sand varies in thickness, but averages 20 ft. Gas occurs in the upper part of the Waltersburg, and control is difficult in some wells owing to the common absence of a shale between the gas and oil sections. The field has recently been extended ½ ml. south, making the dimensions 2½ ml. from north to south and over 1 ml. from east to west. The crude oil has a high salt content, which has reduced its value.

The Waltersburg is near the top of the Chester series, and eight other Chester horizons are known to be productive below it. The Lower Mississippian and the Devonian are prospective oil sources. Some of the Chester sands have had good yields elsewhere.

The discovery well showed oil in the Tar Springs and the Waltersburg. Some of the wells have reached the McClosky and given water.

Drilling and casing details are given. The pressure is nearly 1000 lb./in.², and the daily production is now about 2000 brl. G. D. H.

701.* Illinois Production Tops 400,000 Brl. H. F. Simons. *Oil Gas J.*, 22.2.40, **38** (41), 37, 54.—The daily production of Illinois now averages over 400,000 brl., for there has been an increase of 9750 brl./day at Louden and 12,000 brl./day at Salem. The rapid rise was due to the race to obtain heavy flush production from the Devonian lime. Pipe-line congestion has affected some areas adversely.

Fifty-one wells had been completed to the Devonian lime of the Salem pool between December and 15th February, with a total initial potential of 233,983 brl. Salem production has risen from 185,000 brl./day in the last week of December to 249,000 brl./day.

Development in the Devonian at Centralia is raising production, but the horizon is thinner than at Salem. The Sandoval Devonian pool is almost drilled out, but the Bartelso Devonian is still being exploited. Numerous wildcats are seeking the Devonian. G. D. H.

702.* Mexico—Crude Production and Export Data. Anon. *Oil Gas J.*, 22.2.40, **38** (41), 56–57.—In 1939 Mexico's oil production was 42,479,000 brl. Poza Rica, with 2% of the producing wells, gave 61% of the total oil; the Northern district, with 51% of the wells, gave 13%; the Southern district, with 23% of the wells, gave 11%, and the Isthmus area, with 18% of the wells, gave 15%. Twenty-four wells were completed in 1939, and all except the dry hole at Maguey were in proven territory. The Northern area had three producers and five failures. Five producers and two failures were completed at Poza Rica, and six producers and two failures on the Isthmus. The Maguey well, which went to 8076 ft., had a good show of light oil at 3850 ft.

A deep test is being drilled on the La Presa anticline near Mier, and a well is being drilled for gas production on the adjacent La Lajitas structure.

Exports to Germany were a third of the total exports in 1939.

Tables are given of the exports, export and production taxes, and of the refinery throughputs. G. D. H.

703.* Alberta Prepared to Greatly Expand Oil Operations. J. L. Irwin. *Oil Gas J.*, 29.2.40, **38** (42), 26–27.—In 1939 Alberta's oil production was 7,594,441 brl., an increase of 852,372 brl. over 1938. At the end of the year ninety-three wells were producing from the crude-oil zone at Turner Valley against sixty-four at the end of 1938. Proration prevented the production rising more nearly in proportion to the increase in the number of wells. The crude-oil zone at Turner Valley is now known to be 17 ml. long and 1 ml. wide. 90% of the wells are in the southern 5 ml.

In the Vermillion–Lloydminster field oil is obtained from depths of 1400–2000 ft. The Steveville area is attracting attention, for gas wells have already been completed. During 1939 the following areas were under development: Brazeau, Clearwater, Grease Creek, Kootenay Dome, Moose Dome, Sheppard Creek, Waite Valley, Whiskey Creek, Pouce Coupe, Wainwright, Cardston, Del Bonita, Spring Coulee, and Taber.

Tables give data about Alberta's oil production and about the individual fields. G. D. H.

704.* East Texas Pettit Oil Discovery Result of Long Search. D. H. Stormont. *Oil Gas J.*, 29.2.40, **38** (42), 31, 32, 39.—Since the discovery of distillate production in the Lower Trinity series at Cayuga, the search for oil in this horizon has been intensive. In February, Campbell No. 1 at Chapel Hill gave 225 brl. of oil/day from 8036–8058 ft. The gas–oil ratio was substantially higher than at Shreveport and Lisbon, Louisiana, which are also Pettit fields, although by no means outstanding. 4 ml. south of No. 1 Campbell, and on the south flank of a deep-seated structure, a well has reached 7958 ft., and is south of a well which found distillate production in the Glen Rose. The Paluxy also has shown distillate production.

The original distillate producer at Chapel Hill was high on the structure. Gas produced here would be valuable in the East Texas field 8 ml. to the east. Geophysical surveys have indicated a possible producing area of 12,000–14,000 acres. Gas accumulation at Chapel Hill is probably due in part at least to a stratigraphic trap.

Late in 1939 gas production was opened in the Pettit oolitic lime zone near Groesbeck on a secondary fault zone east of the Mexia fault plane. This also gives distillate production.

At Opelika oil production is obtained from a stray lime in the anhydrite zones in the Middle Glen Rose, and distillate from the Lower Glen Rose. Three deep tests gave two dry holes and a distillate producer.

A table gives the geological markers from the top of the Comanchean to the Lower Trinity. G. D. H.

705.* Sizeable Boom in Progress in Centralia's Townsite Field. H. F. Simons. *Oil Gas J.*, 7.3.40, **38** (43), 18, 19.—More than twelve wells have been completed in the Devonian lime, and many others are under way at Centralia. Up to the present all the new wells have been located in Section 13-1n-1w, Clinton County, but it is evident that the pay zone will cover practically the whole structure, although the production limits will probably not be as great as the Benoist sand pay area, due to sharpening of the structure with depth, and indications that the lime will not be productive as far down dip as the Benoist. The discovery well, an old Benoist well deepened, topped the Devonian at 2863 ft. The pay was encountered from 2903 to 2911 ft., and from 2911 to 2933 ft. However, the latter had a high water content.

The structure is quite regular, although there is considerable variation in porosity and permeability. The average initial production is 500 brl./day, with limits of 250 to 1015 brl. Nearly all the wells make some water (up to 6%). Acid treatment has been applied.

Two attempts have been made to develop McClosky production. Slight shows were found in both, but tests gave considerable water and no free oil.

Drilling details and costs are given. G. D. H.

706.* West Texas Wildcatters Exploit Holt Horizon. R. M. Sanford. *Oil Gas J.*, 7.3.40, **38** (43), 23, 24.—Four wells have succeeded in semi-proving 3500 acres in the Holt horizon along the north-west edge of the North Cowden field. This lies at 5200

ft., 1000 ft. below the regular pay level of the Ector County fields. The discovery well gave 217 brl./day. The structure is believed to be a fold closely following the form of the overlying Middle and Upper Permian beds. Most of the Ector County production is from the Double Mountain series of the Middle Permian. The Holt horizon is a lime member of the Clear Fork series (Lower Permian). Some of the small Double Mountain wells of North Cowden are to be deepened to the Holt.

The saturated thickness of the Holt is 30 ft., and its permeability is low. Acid treatment is highly beneficial. A wildcat north of the Sand Hills field and 40 ml. south of North Cowden has given Holt production at 3635 ft.

Six new deep lime tests are proposed in North Ector County. The results of various wildcats in this region are described. G. D. H.

707.* Dry Holes Limit Music Mountain Pool. J. P. O'Donnell. *Oil Gas J.*, 7.3.40, **38** (43), 17, 99.—The south-western limits of the Music Mountain pool, just outside the recognized limits of the Bradford field, have now been defined. This pool has fifty-eight flowing wells, twenty-four pumpers, and nine gas wells, producing from a formation discovered in 1937, but developed principally in 1939. The best well is said to have given 600 brl. of oil/hour, and the best gasser 15,000,000 cu. ft./day. The area of the pool seems to be 530 acres, its length 3·7 ml., and its breadth less than 1500 ft. The reserves are estimated at 3,000,000 brl. The maximum production has been 7500 brl. of oil/day. The formation pressure was originally 550–650 lb./in.^{2}. Gas injection is now being applied.

It is not known if the sand body is continuous from north to south, on account of an undrilled central area. The pool is regarded as a stratigraphic trap in a shore-line sand. The sand, known as the Sliverville, is coarse and poorly cemented. Its thickness is very variable. Normally oil is encountered within 10 ft. of the top of the sand, but there may be substantial gas pays above the oil.

The Sliverville lies about 250 ft. above the top of the Bradford Third sand, from which other wells in this area produce.

The oil is heavily paraffinic. G. D. H.

708.* Shell to Continue Monte Oscuro Exploration. Anon. *Oil Wkly*, 11.3.40, **97** (1), 56.—A second well is to be drilled on the Monte Oscuro structure to attempt to produce from a 2500-ft. sand, cased off in Monte Oscuro 1, which was abandoned at 9150 ft. Unconfirmed reports say that it made salt water.

Cerro Monte Oscuro is a 17-ml.-long ridge running almost north–south, and lying some 8 ml. east of the Magdalena River and north-east of Nare. It is an asymmetrical anticline which plunges southwards, possibly to a saddle at the Baul River.

G. D. H.

709.* Saudi Arabia Major Factor in Eastern Hemisphere. Anon. *Oil Wkly*, 18.3.40, **97** (2), 56–60.—Commercial production has been developed on the Damman dome and also in Kuwait. Only two wells have been failures out of sixty-seven on Bahrein island, which is estimated to have reserves of 150,000,000 brl. The Damman reserve is put at 300,000,000 brl. The Damman production is piped to Ras Tanura, and recent developments have been confined to the 4300-ft. zone.

Seismic and gravity work is being carried out in Saudi Arabia in addition to geological work and structure drilling. The Abu Hadriya well failed to give anything of commercial importance down to 8655 ft. A second test is being made 120 ml. west of Damman, and on the Qatar peninsula a well has logged commercial showings of oil and gas. Favourable results have been obtained on the Burghan structure. G. D. H.

710.* Argentina's Newest Strike Promises to Rival Famous Comodora Rivadavia. Anon. *Oil Wkly*, 18.3.40, **97** (2), 70–74.—At Tupungato a well was completed with a production of 500 brl. of oil/hr. from a thick Cretaceous sand. The first well found 1000 brl. of oil/day at 1796 m. The reservoir zones are about 252 m. thick. Little is known about the subsurface characteristics of the Tupungato pool.

32 km. north-east of Tupungato at Lunlunta a 240-brl. well was brought in at 2253 m. An area of 400 acres has been proved at Rio Pescado.

Argentina's 1939 production of 2,959,168 cu. m. of oil was 9% higher than in 1938,

320 wells were completed in 1939 against 304 in 1938, the bulk being at Comodora Rivadavia. Gas injection is being applied in three of the country's four main producing districts. G. D. H.

711.* Venezuela to Maintain Important Rank. Anon. *Oil Wkly*, 18.3.40, **97** (2), 84–90.—In 1939 the Venezuelan production rose 9% to 207,952,076 brl., but it will probably fall in 1940, although not due to lack of productive capacity. Completions in 1939 were 415, as compared with 521 in 1938, and 166 were outside the Maracaibo area.

At El Roble the first well was completed at 800 brl./day with eight oil-sands between 8200 and 9600 ft. Other wells have been drilled at El Roble. At Oficina the average initial production per well is 2000 brl., whilst at Jusepin it is 750 brl. from about 4900 ft. Encouraging results have been obtained in wells in the State of Guarico. G. D. H.

712.* Monte Oscuro will Highlight Colombian Developments. Anon. *Oil Wkly*, 18.3.40, **97** (2), 93–95.—An attempt is to be made to establish commercial production from a sand cased off at 2500 ft. in Monte Oscuro 1, which was taken to 9150 ft. The structure is an asymmetrical anticline.

Narino 1 was abandoned in the Oligocene at 6516 ft., owing to mechanical troubles, whilst Peralonza 1 was fishing at 9274 ft. Zambito 1 was completed as a water well at 728 m.

Forty wells were completed on the north dome at Petrolea and one producer at Carbonera. One hundred wells were completed at La Cira in 1939, with an average initial production of 528 brl./day. The Infantas field seems to be drilled up.

Colombia gave 23,774,159 brl. of oil in 1939. G. D. H.

713.* Leasing Indicates Increase in Peruvian Wildcatting. Anon. *Oil Wkly*, 18.3.40, **97** (2), 96–98.—Wildcatting in the Northern National Reserve and deep testing in the adjacent Zorritos field in 1939 gave poor results. In the Pirin National Reserve adjoining Lake Titicaca one well was abandoned and one gave oil and water.

The Aguas Calientes structure east of the Andes is 15 ml. long and 7½ ml. wide, with dips of 20°. The closure is 3600 ft. and the closed area 50,000 acres. The first producing well gave 750 brl. of oil/day at a depth of 1174 ft., and oil is generally at 1020–1250 ft., probably in the Lower Cretaceous, although some have suggested the Jurassic or the Permian. The field is under water drive. There is as yet no outlet for this oil.

Peru produced 13,496,880 brl. of oil in 1939, 40,000 brl. being from Zorritos, 2,650,000 brl. from Lobitos and 10,806,880 brl. from La Brea-Parinas. In the La Brea-Parinas area a deep well has had an initial output of 1500 brl./day from a sand at 4500 ft.

Most of the drilling was rotary. G. D. H.

714.* Ecuador may Record New High Production in 1940. Anon. *Oil Wkly*, 18.3.40, **97** (2), 98.—Ecuador produced 2,260,000 brl. of oil in 1939. The bright spots of 1940 will probably be the continuation of the exploitation of the new crevice production from sands at depths of about 3800 ft., north-east of the Ancon peninsula production. This may be correlatable with the deeper horizons at Santa Elena.

Two unsuccessful wells have been sunk on the San Gabriel concession east of Ancon. G. D. H.

715.* More Testing Needed to Prove Colombian Reserves. F. Mendoza and B. Alvarado. *Oil Wkly*, 18.3.40, **97** (2), 103–124.—The history of the early Colombian oil search and development is given briefly. In particular the question of concessions is described. An account is given of the areas held by the various companies, some of their general activities, refining, and transportation.

The bulk of the crude oil produced from Infantas and La Cira is transported by pipeline over 335 ml. to Cartagena. In both these fields the main production is from an Upper Eocene sand, although some oil comes from the Oligocene. The average depth of the main sand is 3200 ft. Infantas is a faulted north–south anticline with the west flank only oil-bearing. La Cira is a gentle north–south arch. The emulsified crude requires dehydration. Gas is stripped and then used for repressuring.

The Cretaceous, which is predominant in the Eastern Cordillera, is productive in the

Barco concession, whilst the petroliferous Tertiary occupies the middle portion of the Magdalena valley. Oil seeps and mud volcanoes are found on the Atlantic coastal plains, but so far drilling in those regions has not been successful. Wells are to be drilled in the Eastern Plains, and there are various other regions with oil possibilities.
G. D. H.

716.* Late Prospecting Brightens Outlook for Palæozoic Oil in Western Europe. W. A. J. M. Van Waterschoot van der Gracht. *Oil Wkly*, 18.3.40, **97** (2), 126–129.—The foreland of the late Palæozoic Variscan mountains has been considered as possible oil territory. In some respects it resembles the Appalachian belt. However, the Coal Measure rocks in Europe are to some extent buried by Cretaceous and Tertiary, rendering exploration difficult.

The probable source-rocks are marine beds of the Lower Carboniferous and Devonian. The Silurian also is a possible oil source. A large region in Belgium and England is underlain by the Brabant massif, where only pre-Carboniferous rocks with no promise as oil reservoirs occur below the Cretaceous. At Moll a wildcat was drilled to 6500 ft. and abandoned in basal barren Coal Measures. No oil was found, but there was a little gas. In the Westphalian collieries practically no indications of petroleum have ever been found. Near Winterswijk, however, conditions differ, and oil was found in Coal Measure sandstones in four wells drilled for coal. Several deep tests have been made in this area with promising results. Oil showings have been found 900 ft. below the Cretaceous in Carboniferous beds.
G. D. H.

717.* Bulgaria will Continue Oil Search in 1940. Anon. *Oil Wkly*, 18.3.40, **97** (2), 132, 134.—Five areas are of interest with regard to the search for oil in Bulgaria. In the Kostenetz area are valleys filled with Tertiary beds containing coals and bituminous schists. Asphalt veins and bituminous schists are known in the Tertiary of the Kustendil region, but no drilling has been done. North-west Bulgaria is a prolongation of the Rumanian oil basin. There are thick Tertiary deposits, and two bituminous horizons have been noted in Eocene and Pliocene beds. The Provadia district has salt and apparent salt structures. Some shallow drilling has been carried out. The Varna district possesses gas seeps, probably arising from the Oligocene.

The eastern part of the Stara-Planina, or Balkan mountain range, resembles the Carpathians, and has hydrogen sulphide and other gas seeps. It is considered one of the most promising areas in Bulgaria as regards oil.
G. D. H.

718.* Turkey Continues Testing Despite Disappointments. Anon. *Oil Wkly*, 18.3.40, **97** (2), 139, 142.—The oil search in Turkey has continued since 1934 without establishing commercial production. A well on the Basbirin structure 70 km. north of Mardin was drilled to 4351 ft. and abandoned in water. One at Hermis in the Midyat region went to 3088 ft. and found many shows of oil, gas, and asphalt. A nearby well had similar showings. A well at Kerbent was abandoned at 3380 ft. in salt water. North of the Tigris a well at Raman Dag is below 2000 ft. Deep drilling has been begun on the Cukorova plains. To the end of 1939 seventeen wildcats had been sunk that had slight oil showings, but all were relatively shallow.
G. D. H.

719.* Rumanian Outlook Clouded. Anon. *Oil Wkly*, 18.3.40, **97** (2), 147–150. In 1939 the Rumanian oil production continued the downward trend and fell by 6·8% to 45,640,000 brl. Baicoi-Tintea and Ceptura were the only fields where the production rose during the year. Drilling was 11% less than in the previous year. The difficulty of obtaining sufficiently large blocks of land has restricted exploratory work, as have also political considerations and currency and trade difficulties.

Only seven wildcats were drilled in 1939. Bucsani in 1934 was the last major oil strike, and the Baicoi-Tintea Meotic of 1937 the latest deep sand strike of importance. Eleven of the 1939 completions went to 9870 ft. or more. The deepest production is from 10,560 ft.
G. D. H.

720.* Alberta has Attained Stabilized Position. F. K. Beach. *Oil Wkly*, 18.3.40, **97** (2), 170–180.—Only in 1937 did Alberta's production begin to approach its demand for oil. In 1939 the production was 7,594,411 brl., against 6,742,039 brl. in 1938. New refinery facilities have been provided which show that a high-octane gasoline fuel can be made from Alberta crude without blending with imported stocks.

Considerable wildcatting has been carried on, and the major field has been developed in the disturbed foothill belt. Tests have been made in the geosyncline to the east, and although favourable indications have been found, no production has been obtained. In the deepest part the limestone is about 9000 ft. deep. Several fields have been developed in the plains, mostly giving heavy oil from fairly thin sands. Wainwright is the largest field in that area, and wells have also found oil near Lloydminster and Del Bonita. The Turner Valley field is about 16 ml. long, with the main production so far in the south. On the east is the gas cap, whilst the western boundary of the oil is marked by salt water.

Wainwright is 4 ml. long and almost as wide, with oil in thin Lower Cretaceous sands. Isolated wells have been drilled at Taber, Skiff, Dina, Vermillion, and Bragg Creek.

At Medicine Hat gas has been produced since 1890 from the Upper Colorado. Bow Island gave gas, and has been repressured from Turner Valley. Foremost is a small terrace structure, whilst Steveville gives gas from the Madison limestone contact, and has shown oil. Viking has given gas since 1923 from a sand in the Colorado shale. Kinsella also yields gas. At Brazeau a heavy gas flow was met, and the Madison is expected at 8000 ft. The Clearwater well found several oil zones in the Devonian. At Grease Creek an oil showing has been noted over the Madison, and some production from the Devonian has been obtained at Moose Dome. The findings of various other wildcats are noted. G. D. H.

721.* British Columbia Government Launches Independent Exploration Program. Anon. *Oil Wkly*, 18.3.40, **97** (2), 179.—Field work was carried out in the Peace River area as early as 1919, and in 1938 the matter was re-examined with a definite view to testing. The early work showed an area of complex folding with simpler structures immediately to the east. Favourable structures occur at Hudson Hope, Moberly Lake, and where Commotion Creek joins Pine River, but a little to the west are complex structures like Turner Valley, whilst to the east the structures are not sufficiently well defined to warrant early testing. The structure at Commotion Creek and Pine River has been selected for testing. It is 10 ml. long and 4 ml. wide, with the Palæozoic, which is known to be petroliferous, at a depth of about 6600 ft. G. D. H.

722.* Tests in Alaska Reveal Deep Possibilities. Anon. *Oil Wkly*, 18.3.40, **97** (2), 185–189.—At Chinitna Bay drilling was recommenced at a depth of 7156 ft. in May 1939, and in the next thousand feet several thin bodies of oil-sand were met. At 8734 ft. a salt water sand was penetrated which could not be shut off for lack of supplies Some oil, gas, and salt water flowed from this well and its closed-in pressure built up to 2000 lb./in.^{2}. Oil and gas had been met at various points from 4600 ft. downwards. This well lies on the top of a dome. The original objective was not reached.

150 ml. to the south at Jutebay a well reached a depth of 6907 ft. without finding commercial oil production.

Oil occurs in the Yakataga–Katalla area, the Chinitna–Chignik region, and near Smith Bay in the extreme north. Commercial production has been obtained. at Katalla only, at which place there are many seepages of paraffin base oil. G. D. H.

723.* Hispaniola—a New Oil Province. F. B. Plummer. *Oil Wkly*, 18.3.40, **97** (2), 193–196.—The climate, geography, and history of Hispaniola are described.

The strata of which the island is composed are highly compressed and folded into east–west mountain ranges, of which there are three. The Cordillera Central consists of metamorphic and igneous rocks, the Sierra de Barohuca in the south of igneous and sedimentary rocks, and the Cordillera Septentrional of the north mostly of highly tilted Tertiary beds. The Cretaceous beds are strongly contorted and altered, whilst the Eocene has a thick section of limestone and some shale. The Oligocene has three divisions: at the top a massive, poorly bedded limestone with pebbles and conglomerate; in the middle a massive, coarse, alluvial fan-like conglomerate, and at the base a thin-bedded carbonaceous shale with the appearance of being a good source rock. The Miocene consists of the Upper Yaque marl with sand and conglomerate layers, a middle fossiliferous limestone and the Lower Yaque marl with sand lenses. This last appears to be a source rock, and the oil now produced probably comes from this part of the section. Recent beds rest on the Miocene.

Oil-bearing structures occur in geosynclinal valleys and are generally long, narrow anticlines with steep dips and large closure. There are numerous normal and thrust

faults. Five well-closed anticlines are known—Melano, El Higuerito, Quita Corriza, Canoa, and Monte Cristi. Almost all the drilling has been on El Higuerito. Oil was found in two tests at about 580 ft. in a sand in the Lower Yaque. Most of the wells on El Higuerito had good showings and one gave several barrels of oil.

The prospects of oil in the Miocene and Oligocene seem good, particularly on the northern and southern margins of the island and on the west coast of Haiti.

G. D. H.

724.* Fifty Rigs Kept Busy as Cuba Attains Peak. Anon. *Oil Wkly*, 18.3.40, **97** (2), 199–200.—Nineteen operating companies with fifty drilling rigs are at work in the Montembo basin of Cuba. On the most active concession seventy-five wells were put on production in 1939, giving 54–125 gal. of gasoline/day.

Ariguanabo No. 1, drilled after seismic and torsion balance work, found several oil indications in the Oligocene and signs of oil in sandy phases of Upper Cretaceous shales and in tuffaceous conglomerates. A second well put down half a mile away went to 10,034 ft. and found oil shows but no commercial production. A well 1¼ ml. south-west of Remedios on a long, narrow structure found oil indications in the Remedios Group limestone at 2306 ft., where there were fine asphalt-filled veins. North-east of Colon a well was abandoned at 6200 ft.

In February the Montembo basin was giving 200 brl./day and the Bacuranao basin 14 brl./day.

G. D. H.

725.* Japanese Entry Alters Mexican Prospects. Anon. *Oil Wkly*, 18.3.40, **97** (2), 209–216.—As a consequence of the declaration of certain patents as being void, lead tetra-ethyl will now be manufactured in Mexico, and so render possible the improvement of motor spirit.

There have been further labour troubles.

Fourteen out of twenty-four wells were completed as producers in 1939, with an initial aggregate output of 27,064 brl./day. The most prolific wells were in the Poza Rica field. In the Northern district the average depth of the new wells was 1866 ft., but in the Southern district 7769 ft. On the Isthmus of Tehuantepec the average was 2675 ft. Maguey 1 in Tampacan had a gas blow-out at 3850 ft. with 20–25 brl./day of 44 gravity oil, but the well was taken to 8076 ft. in the Jurassic for a dry hole. It was not possible to obtain a permit to test the shallow showing.

Poza Rica's oil production has increased, whereas the Northern, Southern, and Isthmus fields have declined. Up to the beginning of 1940, 6527 wells had been drilled in Mexico, of which 2596 were producers.

Various statistics are tabulated.

G. D. H.

726.* Australian Wildcatting again Starts from Scratch. Anon. *Oil Wkly*, 25.3.40, **97** (3), 54.—Following surveys in the Kimberley region of north-west Western Australia a trial bore was started at Nerrima, 200 ml. south-east of Broome. At the end of 1939 it was only at 1240 ft., having been hindered by caving in the Noonkanbah series. No oil or gas had been recorded. Similarly a bore at Mount Gambier, South Australia, reached 552 ft. without any oil showing.

The Imray well was completed in the Lakes Entrance district at 1273 ft., and gave 7 gal. of oil/day from a glauconitic horizon at 1253 ft. An air repressuring scheme was under consideration.

At Metung, west of Lakes Entrance, a well reached 1550 ft. and reported dry gas, water, and traces of oil. A second well was drilling at 500 ft. Wells at Lake Boga, Portland, and Nelson, in Victoria, were at depths of 735, 1500, and 1480 ft., respectively, at the end of 1939. The last well had entered granite. At Dutson a well was drilled to 1670 ft. without any sign of oil or gas.

Some thirty-five bores totalling 45,000 ft. have been drilled in the Gippsland area without giving oil or gas. Three wells penetrated the full sequence of Tertiary beds. One south of Bairnsdale entered the Jurassic at 3158 ft.; another east of Sale entered Silurian at 3443 ft., and a third at Paynesville entered the Jurassic at 2966 ft.

The Kulnura boring, which had shown several gas horizons, was taken to 6000 ft. Dry gas at 80 lb./in.^{2} has been obtained at Balmain Colliery, near Sydney.

Work was resumed in the Arcadia and Hutton Creek bores. The first showed wet gas, and the second, deepened to 4688 ft., was awaiting the testing of gas horizons

below 3700 ft. Traces of oil and gas in quantity were found in a bore at Mount Basset near Roma. G. D. H.

727.* Effect of Faulting on Accumulation and Drainage of Oil and Gas in the Wilmington Oil-field. R. Winterburn. *Petrol. Tech.*, Feb. 1940, A.I.M.M.E. Tech. Pub. No. 1154, 1–17.—The beds encountered in the Wilmington field range Miocene to Quaternary, with the Tar, Ranger, Terminal, and Ford producing zones in the Miocene and Pliocene. The developed field is on an anticlinal nose plunging north-west, whilst the four main faults, dividing the field into five structural blocks complicated by minor faulting, run north–south transverse to the axis. One main fault dips west, but the others dip east at 50–60°. The throws are generally 100–250 ft., but some faults die out. Faulting and folding seem to have occurred progressively during Repetto deposition.

The edgewater condition in each fault block is distinctive and unrelated to adjacent blocks. The fault planes seem to form impervious barriers even when pervious beds are against pervious beds, for in many places there are several hundred feet of grey water sands with interbedded shale in contact along a fault with several hundred feet of oil sands and interbedded shale which produce clean oil. In many places the gravity of the oil produced in the various zones shows marked differences on opposite sides of the faults. Gravities conform to structure on each block. Productivity differs on opposite sides of faults. The formation pressures afford evidence that the faults are effective as barriers to the movement of fluids with differential pressures of as much as 400 lb./in.^{2} across the faults.

Accumulation seems to have occurred in each block independently without fluid movement across the faults. The faults are still effective as barriers. The sealing effect of the fault may be due to a continuous layer of impervious gouge material or to the fact that each bed of sand has been rendered relatively impermeable immediately adjacent to the plane of movement by crushing, shearing, and the development of thin seams of clayey material cutting across the bedding planes.

The effect of the faults on development and production practice is discussed.

G. D. H.

728.* Forest City Basin Chances Enhanced by Oil Strike. H. McClellan. *Oil Wkly.*, 4.3.40, **96** (13), 17–20.—Oil has been found in the Hunton limestone at a depth of 2279–2285 ft. in the Forest City basin. From the basement upwards the following formations are present: Basal sand (Camb.), Arbuckle limestone, St. Peter sand, Galena–Platteville limestone and dolomite, Maquoketa shale (Ord.), Hunton limestone (Sil.-Dev.), Kinderhook shale, Mississippi lime (Miss.), Cherokee shale, Marmaton group, Missouri series, Virgil series (Penn.), and Big Blue series (Perm.). This basin, lying in North-east Kansas, is a narrow trough east of the Nemaha granite ridge. Its west flank dips steeply, whilst the east flank is gentle. The region suffered post-Hunton uplift, and there was post-Mississippian folding, during which the granite ridge was probably formed, and the Forest City basin appeared.

The history of the area is such that oil may have varied in its site of accumulation as the strength of the basin and the position of its axis changed. The west flank is believed to be so steep as to have lost all oil at the fault line, but the east flank may have comparatively shallow structural or stratigraphic traps. G. D. H.

729.* U.S.S.R.: Petroleum in the Third Five-Year Plan. Anon. *Rev. Petrol.*, 16.3.40 (879), 172–173.—It is proposed to produce 48·5 million tonnes of oil in 1942, an increase of 70% over 1939. This will entail drilling 5 million metres in 1942 against 1·9 million metres in 1939. Small wells will be put back on production and gas wastage eliminated. The Ural–Volga region in particular will be developed. This gave 3·6% of the Russian production in 1937 as compared with 0·2% in 1933. It is proposed to raise its output to 7 million tonnes in 1942, and pipe-lines and refineries are to be constructed accordingly. The production of the Emba region will be raised to 2·1 million tonnes in 1942.

In 1938 Russian geologists estimated the reserves to be 8640 million tonnes. Extensive hydrogenation is to be undertaken and synthetic processes started to utilize gas.

It may be noted that the production in the 1933–1937 period was 24% below the project.

The refinery capacity will have to be almost doubled to meet the increased output, and the vulnerability of the Caucasian region, which gives 90% of the production, is undoubtedly the reason for the strenuous efforts to develop the Emba and other areas. G. D. H.

730. **Subsurface Geology and Oil and Gas Resources of Osage County (Oklahoma). Part III. Townships 24 and 25 North, Ranges 8 and 9 East.** N. W. Bass, L. E. Kennedy, J. N. Conley, and J. H. Hengst. *Bull. U.S. Geol. Surv.*, 900-C, September 1939.—This report deals with the oil- and gas-fields in an area in Osage County lying about 30 miles north-west of Tulsa. Some 1550 wells have been sunk, including dry holes in this area, and oil and gas have been produced from seventeen zones, ranging in depth from 200 to over 2900 ft. The oil-producing formations concerned are the Ordovician, the Mississippian–Pennsylvanian contact, and the Pennsylvanian series. Details are given of the several oil and gas zones and of the subsurface structure embracing them. The area has not been completely explored by drilling, and a few localities within and adjacent to it have yet to be tested, the prospects being good. H. B. M.

731.* **Oil Deposit of Ekinveren, Turkey.** G. Petounnikoff. *Petrol. Z.*, May 1939, **35** (18), 315.—Ekinveren is a village lying to the south of the town of Sinope, and the geology is essentially Upper Cretaceous deposits overlying highly folded Albian–Aptian beds. The latter are involved in much-faulted anticlinal folds, and petroleum seepages are found in fissures. The oil is "mined" by means of horizontal galleries intersecting the fissures, and is apparently mainly used as a grease. 72% distils over 310° C. and has a gravity of 0·923. H. B. M.

732. **Oil in Palestine.** Anon. *Bull. Imp. Inst.*, 1940, **38** (1), 96.—According to a report by the Government Geologist to the Imperial Institute, interest in prospecting for oil has been maintained, but so far commercial production has not been achieved. Oil-prospecting licences now in force number thirty-one. The districts concerned include Jebel Usdum, where there are oil seepages and bituminous deposits; Nabi Musa and Yarmuk, where bituminous limestones are developed; Gaza, where several structures have been located but not yet tested. H. B. M.

733. **Oil in Uganda.** Anon. *Bull. Imp. Inst.*, 1940, **38** (1), 98.—The Director of the Geological Survey of Uganda reports to the Imperial Institute that a second deep boring for oil was put down near the hot springs at Kibero and was drilled to 2245 ft., when it was stopped. A new borehole is being put down to test possibilities about 1 mile to the north of the original site. (See also Abs. 414.) H. B. M.

734. **Principles and Methods Adopted in the Development of Petroleum Deposits at Devoli.** P. V. Borgucci. *Riv. ital. del Petrolio*, July 1939, **7** (75), 4–5).—The article includes a general description of the stratigraphical characteristics of the petroleum deposits of Devoli (Albania) and a survey of conditions peculiar to the region which have necessitated certain departures from normal rotary drilling technique. The most important of these are complete electrification of the whole field and centralization of power production. Problems of conservation of gas and pressure within the formation are dealt with, and note is taken of experimental methods adopted for the recovery of natural gas. H. B. M.

735. **San Juan Country. A Geographic and Geologic Reconnaissance of South-eastern Utah.** H. E. Gregory. U.S. Geological Survey. Professional Paper No. 188.—This paper contains an account of a pioneer well drilled near the Goodbridge bridge on the San Juan in 1908 which led to the drilling of more than fifty wells in the Goodbridge field and adjoining regions and to the study of oil possibilities in the whole of south-eastern Utah.

Exploration has for the most part been along the San Juan River, but potential oil-bearing anticlines have been mapped at Fish Creek, Elk Ridge, and Beef Basin; claims have also been staked on northern Sage Plain, Grand Gulch Plateau, and westward to Glen Canyon.

The oil in the San Juan country occurs in the Hermosa and Rico formations, which contain many oil-bearing sands. All the wells in the field have been drilled in these

formations, and at least two of them passed entirely through the Hermosa and possibly older limestone and entered mica-schist of Pre-Cambrian age. In some places the sands are as much as 50 ft. thick. In certain cases it is uniformly porous, as evidenced by the saturation of unbroken rock; in others the oil stains are irregularly distributed along joints and cracks, thus indicating that the sandstone is not uniformly porous. Only a few of the wells drilled in the Goodbridge field have produced large quantities of oil: this fact suggests that the oil in the sands is pockety and discovery by the drill more or less accidental.

Although the original source of petroleum in the San Juan area is unknown, it is evident that its accumulation has been controlled by local structure, climate, and geomorphic features. A series of north–south anticlines and synclines favour accumulation, but nevertheless this is hindered by the aridity of the region and by the canyons. Throughout long periods the strata are drained of water nearly to the bottom of the canyons. The height to which oil may rise depends to a large extent on the amount of oil and water available to fill the pores of the rock. In the case of San Juan Canyon ground water and oil seeps emerge into the bottom of the canyon. H. B. M.

Geophysics.

736.* Propagation of Elastic Waves in the Earth. L. G. Howell, C. H. Kean, and R. R. Thompson. *Geophys.*, 1940, **5** (1), 1–14.—The propagation of waves of single frequencies varying from 100 to 2000 cycles/sec. was studied. The sources of vibration were of two types: an electrodynamic shaker and a magnetostriction tube. The normal electromagnetic pick-ups are not suitable for recording high frequencies, so a special piezo-electric pick-up was designed. The work done showed that in the dry surface layers the attenuation to high frequencies is very great, but this is considerably less marked in the deeper, water-saturated beds. Low frequencies are not seriously attenuated in the surface layers, but in the deeper beds the effect is of the same order as for high frequencies. In the case of horizontal refraction profiles, using high-frequency pulses, the velocities are approximately the same as the velocity of sound in water. The travel–time curves are straight lines through the origin, and the amplitude does not fall off with distance as fast as might be expected from vertical transmission data. S. E. C.

737.* Velocity Stratification as an Aid to Correlation. R. F. Beers. *Geophys.*, 1940, **5** (1), 15–21.—Refraction work in the Permian Basin of West Texas showed that the various sediments have characteristic seismic velocities and that it is possible to correlate on the basis of those velocities. Reflection work has since shown that the differences in horizontal velocities are more marked than those in vertical velocities. Because of its wide range—2000–24,000 ft./sec.—the velocity of propagation of seismic waves is one of the most characteristic properties of a sediment. The difficulty lies in accurate measurement of times of travel, since they are so small, but improved methods are being developed. Sufficient evidence has been obtained to show that the correlation of lithologic units can be established over considerable distances by means of their individual velocities, and obscure stratigraphical relationships have been elucidated in this manner. In addition, accurate velocity data make possible the certain identification of reflecting horizons. Further experience will show whether such data will assist in the discovery of stratigraphic traps. S. E. C.

738.* Experimental Device for Computing Magnetic and Gravitational Anomalies. J. W. Fisher. *Geophys.*, 1940, **5** (1), 22–30.—The gravitational and magnetic anomalies due to a horizontal slab of material bounded by a given contour can be expressed in terms of the solid angle subtended by the contour at the point where the anomalies are measured. This principle is used in the design of a device which enables one to make direct measurements of the anomalies given by any structure. A coil of wire, carrying an alternating current, is so wound around a model of the structure that the vertical spacing of the coils is kept constant. For the measurement of magnetic anomalies, a small, very compact search coil is held in the position at which the anomaly is to be measured and the mutual induction between the two coils determined. The values obtained for any positions of the search coil will give the relative magnitudes of the

vertical magnetic anomalies at those points. For the determination of the gravitational anomaly, a long, thin solenoid is used instead of the search coil.

S. E. C.

739.* Direct Method of Interpretation in Resistivity Prospecting. C. L. Pekeris. *Geophys.*, 1940, **5** (1), 31–42.—In this method the variation in conductivity with depth is determined for the case of horizontal layers. The procedure is outlined and an example worked through to illustrate its application. The theory on which the method is based is given.

S. E. C.

740.* Three-layer Resistivity Curves for the Eltran Electrode Configuration. S. S. West. *Geophys.*, 1940, **5** (1), 43–46.—A set of standard curves, log. of apparent resistivity plotted against log. of electrode separation, for the case of three layers, and based on the Wenner electrode pattern, has been published. A method is now given whereby the curves for other electrode patterns can be calculated from this published data. Data are given for plotting the curves for the Eltran electrode pattern.

S. E. C.

741.* Additional Evidence on the Relation of Temperature to Structure in the Salt Creek Oil-field, Natrona County, Wyoming. C. E. van Orstrand. *Geophys.*, 1940, **5** (1), 47–56.—The structure at Salt Creek is a closed dome with transverse faults. The physical conditions, with the exception of the faults, are uniform, and granite is found at moderate depths below the top of the structure. The field therefore offers an excellent example for determining the relationship between temperature and structure. The first sets of temperature measurements were made in 1922–1923 in twenty-one wells which had remained idle for sufficient time to give thermal equilibrium. These measurements show a very close relationship between temperature and structure. Later measurements, made in nearly one hundred wells when the field was in a state of decline production, confirm this relationship. The disturbing effect of repressuring and producing operations on the thermal gradient is well illustrated in the case of six wells.

S. E. C.

742.* Geothermal Methods of Estimating the Age of the Earth. C. E. van Orstrand. *Geophys.*, 1940, **5** (1), 57–79.—Tables are given whereby the temperatures in a non-radioactive earth can be calculated and a general idea obtained of the temperatures in the case of a radioactive earth. It is found that a temperature of 76,000° C. at the centre of the earth is consistent with the low-temperature gradients observed in areas that have remained practically undisturbed through long periods of time. Radioactivity alone is insufficient to cause melting at depths of the order of 30 kilometres, but at depths of 500 kilometres it is possible. Between those depths the combined effects of heating and cooling may result in volume changes through recrystallization of substances near their critical temperatures. The age of the earth obtained by geothermal equations is consistent with that obtained by the method of atomic disintegration.

S. E. C.

743.* Results of a Deep Boring at the Tegernsee, Upper Bavaria. J. Knauer. *Oel u. Kohle*, 1940, **36** (7), 63–66.—Reichsbohrung 429 was drilled to a depth of 2199 m. during 1937–1939, the location being in the Flysch zone on the western side of the lake. The strata below the Flysch cover includes the Cretaceous stages from the Barremian to the Maestrichtian and the Middle and Upper Eocene. These strata are strongly folded and are in part repeated several times. As a result of this repetition, rocks of other ages were not found in the boring. This boring does not solve the problem of the origin of Tegernsee oil. However, it does point to the oil being older than the Barremian, and a Palæozoic origin is consequently not out of the question.

S. E. C.

744.* Application of the Schmidt Field Balance to the Search for Oil Deposits. G. Neumann. *Oel u. Kohle*, 1940, **36** (9), 75–78.—The early application of the Schmidt magnetic field balance to the discovery of salt domes was not successful. Later improvements in the instrument have made possible the accurate measurement of anomalies of the order of 10–15 γ, and the method is now being used in the Gulf Coast, These measurements, however, should be considered not as an independent geophysical

method for the search for structures, but rather as a contribution to the clarification of the sedimentary tectonics.

In regions where there are buried crystalline or early Palæozoic uplifts the magnetic method may be used for regional surveys on which the detailed exploration can be based. In certain cases the method may also be used for detailed work, for although usually it does not give a complete picture of the structure, it does indicate the position of the crystalline core, and hence the probable position of the crest of the structure. The application of the method is similar in the case of areas where the tectonics are determined by later volcanism.

The magnetic method will determine the position of faults in those cases where the fault-plane has been extensively injected with intrusive material, or where the fault cuts the crystalline basement as well as the overlying sediments. S. E. C.

745.* Importance of Geophysical Exploration and its Application in the Argentine Republic. Francisco P. de Luca Muro. *Bol. Inform. Petroleras*, Dec. 1939, XVI (184), 35–45.—This article describes in simple language the different methods adopted by geophysicists in studying the character of substrata in the search for petroleum deposits. Remarkable development of these methods and of the instruments used has taken place in the last few years. Present tendency is to apply the gravimetric method as an initial stage, followed by further investigation by the reflection method of seismic prospecting. A useful bibliography of the subject is appended. H. I. L.

Drilling.

746.* Use of Fill-Up Line Decreases Blow-outs. H. F. Simons. *Oil Gas J.*, 7.3.40, **38** (43), 36.—The causes of abnormally high pressures encountered are given in the cases of small gas pockets which may only disturb the drilling fluid without serious mishap, as well as in the case of meeting with extensive and abnormally high-pressure gas reservoirs. Blow-outs occur when the hydrostatic head of the drilling fluid is insufficient to balance the formation pressure. A special study is made of the case where the fluid column is shortened by withdrawal of the drill-pipe from the hole.

Blow-outs occurring on withdrawal of pipe have been ascribed to the "piston effect" of such a procedure. It is shown that this is not the case with the majority of blow-outs so occurring, the real reason being the fall in liquid level and, consequently, in hydrostatic head exerted on the formation.

A drawing and description are given for a fill-up line to be connected to the well, below the preventer, in order to fill the well with mud as the drill-pipe is withdrawn. Various methods of rendering this operation simple and foolproof are outlined.

Another danger of blow-out which results from making a trip is the forcing of air into the mud while filling the pipe after the bit has reached bottom. Procedures to be followed to avoid such a danger are given for various cases. A. H. N.

747.* Maritime and Land Operations Contrasted in Chalkey Field. N. Williams. *Oil Gas J.*, 7.3.40, **38** (43), 40.—One of two operating companies on coastal Louisiana is developing its properties by the land route, building a good road system, whilst on immediately adjacent properties the other company is operating by water. The latter system is studied in greater detail than the former.

Although maritime development has its advantages in effecting substantial savings in time and cost of well moves, transportation, hauling and other handling problems, this method is generally used as a matter of necessity or expediency, and not of choice. The canal system was dry cut, and the cost has been found to be substantially less than would have been required to build roads and also less than the usual cost of dredging in marshes. Even laying of temporary plank roadways would have involved a greater initial outlay. Drag-lines have been used in excavating the canals. The system and its development are described.

The canal system facilitates the movements of pipe and other equipments as well as of the products from the wells directly upon production.

Details of operations in Chalkey field are given and its development is briefly reviewed. A. H. N.

748.* New Combination Degasser and Agitator. L. P. Stockman. *Oil Gas J.*, 21.3.40, **38** (45), 63.—A description is given of an agitator and degasser, the primary function of which appears to be to reduce drilling costs through mud reconditioning by breaking down the viscosity of the drilling fluid, releasing entrained gas or air, and eliminating the necessity of continually replacing weight materials and certain chemicals in the mud.

The combination consists of a vertical steel tower with a combination of baffles and nozzles arranged to secure maximum agitation of the mud under a sustained vacuum. Details of its construction and operation are given, as well as its capacity for treating mud.

An advantage claimed for this degasser combination is that its use definitely reduces drill-pipe corrosion. A. H. N.

749.* Drilling Activity is Showing Increase. H. F. Simons. *Oil Gas J.*, 28.3.40, **38** (46), 52.—Statistical data are presented for the number of completions by weeks for 1939 and 1940, drilling tests completed annually from 1919 to 1940, and comparative drilling activity for various States of America. It is concluded that during 1940 activities will show a definite increase. A. H. N.

750.* Chemicals in Drilling and Producing Operations. W. W. Robinson. *Oil Gas J.*, 28.3.40, **38** (46), 190.—*Paper presented before American Petroleum Institute.* This long paper considers broadly the steadily growing trend in the application of chemicals to problems affecting the drilling for and production of oil. Chemicals for treatment of muds, the control of heaving shales, treatments for lost circulation, special cements, the use of acids, selective water shut-offs, and the application of surface-tension-reducing agents are reviewed in their relationship to the growing chemical technology which has already been of material assistance to the driller and producer.

The treatment of muds is considered from the viewpoints of weighting and increasing colloidal content, control of viscosity of muds by the addition of reagents, the use of carbonates, silicates, tannate and phosphate salts of sodium, the use of special drilling fluids and fibrous materials, together with a study of the interrelationship of the various properties of muds and the effects of the addition of such reagents on these properties.

The study of the cements includes the study of the chemical entities of the cement itself as well as of the reagents. The methods of increasing the setting time of cement by chemical means are discussed.

Acidization is outlined and a detailed account is given of inhibition and inhibitors. Addition agents, besides inhibitors, include those which speed up the action of acid on dolomitic limestone, those which retard the action on fast limestone, those which reduce the surface tension of the acid and permit the effective withdrawal of the reaction products, and those which permit the acid to "wet through" or penetrate oil-soaked limestone or mud cake.

The paper concludes by reviewing the chemicals used in selective exclusion of water and reduced surface tension washes.

The bibliography contains 86 references. A. H. N.

751.* Oversize Joints Reduce Drilling Costs in Illinois Basin. H. F. Simons. *Oil Gas J.*, 28.3.40, **38** (46), 197.—One of the principal items which added to the drilling costs in the Illinois basin development was the excessive wear on tool joints and drill-pipe, the average drill-stem making only about half the footage it would make in other areas. The average life of a standard tool joint set was 20,000–30,000 ft.

By using an oversize joint which increased the outside diameter by $\frac{1}{4}$ in., it was made possible to obtain footages of 33,000–36,000 ft., an increase of 33%. The increase in cost of the oversize joints over standard joints was 5%.

The chief danger arising from the use of oversize joints was in case of a fishing job being necessary. There was only $\frac{1}{4}$-in. clearance to get over the fish when using these oversize tool joints and a standard overshot. A. H. N.

752.* Causes and Preventions of Stuck Drill-Pipe. J. E. Warren. *Oil Gas J.*, 4.4.40, **38** (47), 39; also *Oil Wkly*, 1.4.40, **97** (4), 12–15 (Pt. I only).—*Paper presented before American Petroleum Institute.* Various factors which may cause drill-pipe to stick in

the well bore are discussed. These factors include key seating, which occurs when the portion of the drill-pipe which is under tension is brought against the convex side of a crooked well. The pipe tends to drill itself into the walls of the well. Drilling straight holes eliminates this source of danger. Reaming a crooked well cures the fault.

Other factors are improper mud control, cuttings, sand and cavings, and balling-up. Admixtures to increase weight of mud, even if finely pulverized, will settle down and freeze the pipe if the mud is deficient in gel-forming colloids. Filter-cake formation is another important consideration. Cavings, washout, and solution of soluble formation minerals will increase the diameter of the hole where they occur. This results in a drop in the velocity of the mud passing that section of the well, with a consequent tendency for the cuttings and sands to settle and freeze the pipe. Mud conditioning can prevent such dangers. Balling-up refers to the accumulation of sticky mud or formation on the bit or drill assembly. On withdrawal of the drill-stem this accumulation is compacted and may stick the pipe.

The methods of recovering stuck pipe are considered in two classifications. The first includes those methods used to free drill-pipe while keeping the drill-stem intact. Included are the use of oil, circulating clear water, gas slugging, and mechanical methods such as spudding and bumping the pipe. The second includes those methods which are used in case the drill-pipe cannot be freed while it is intact as one unit. This includes "backing off," the use of inside cutters, shooting off pipe, "washing over," use of jars, etc.

Some of the methods require the use of special tools and the service of operators skilled in their use. The application of these methods and a brief description of the procedure used are given. A. H. N.

753.* High Rotary Speeds in California Drilling. W. A. Sawdon. *Petrol. Engr*, March 1940, **11** (6), 33.—High rotating speed was so successful in drilling straight, fast holes to depths of 10,000 ft. and more that it practically established a new technique. Rock bits were used almost invariably, and speeds were estimated at 750 r.p.m. The object of these very high speeds was to drill a straight, fast hole with the minimum cost and trouble. The verticality of the surface string was a most important factor. Rock bits with different types of cones were used at different depths and, in general, fine teeth were used at low depths. No bit less than 11 in. in diameter would be used for speeds of 400 r.p.m. and over. Octagonal kellys were used exclusively. The drill-pipe was in tension at all points down till the collar. Detailed accounts are given for bit-speeds programmes.

The practice may be summarized as follows. The drill-pipe is rotated at a high speed until the top of the kelly is near the table. The rotating speed is then slowed down and another foot of hole made with slow rotation. After adding another stand of pipe, the bit is set on bottom and rotation begun slowly to make sure the cones are turning. The table is then speeded up and the procedure repeated.

The reason for slowing down rotation for a short time before breaking connections is to allow the bit to cool. Otherwise the heat generated in the bit by the high-speed rotation would force all water from the mud and bake it in and around the bit to such a degree that the cutter would be frozen on the bit and would not turn.

Critical speeds occur where the pipe vibrates excessively. Methods of remedying this fault are given.

The rate of penetration at the highest rotating speed after setting the surface string averaged 40 ft. in 4 min. It took longer to make the connections than it did to run down the kelly. A. H. N.

754.* Deepening and Completing a Well in the Lisbon Field, Louisiana. Part II. P. D. Torrey and F. H. Miller. *Petrol. Engr*, March 1940, **11** (6), 48.—In this exhaustive paper an extremely detailed account is given of the operations and equipment used in deepening a well. The first part dealt with the geology of the district. In this, the second part, the geology section is concluded and drilling is discussed. Conditioning of the hole, equipment used, tests conducted on mud conditioning, and the control and verticality of the well are presented in a complete form.

The paper ends with a description of a sample taker which, it is claimed, provides absolutely representative cuttings between any depth limits desired. It consists essentially of a paddle-wheel, driven by the mud stream itself, which in turn rotates

a cylindrical screen set to take a small portion of the mud stream. The sample of mud and cutting is washed by small jets of water, and the cuttings are collected in a clean and representative manner in a sample holder. A. H. N.

755.* Layout and Care of Rotary Drilling Equipment. H. L. Flood. *Petrol. Engr*, March 1940, **11** (6), 189.—Changes are taking place imperceptibly in all departments of oil-field equipments and operations. The use of paint provides an instance in the change of outlook and practice. Formerly the only reason given for using paint was appearance, and hence it was used sparingly. Now it is recognized that painting the equipment pays a dividend, as it prevents excessive rust and corrosion and increases the efficiency of the personnel. A rig which is uniquely painted all white is made the subject of the paper in particular. The use of light colours is advocated on the basis of increasing the pride of the workmen in the equipment, and hence increasing their output.

The draw-works is totally enclosed, and provides a high factor of safety to the crew and a compact space-saving equipment.

Improved methods of controls for the draw-works and the rotary and general equipment are discussed. A. H. N.

756.* Mud Control Requires Knowledge of Basic Fundamentals. B. Mills. *Oil Wkly*, 4.3.40, **96** (13), 12–16.—The early development of mud control and usages from water circulation onwards is summarized. The need for the various properties considered essential in modern mud practice is outlined.

Nowadays the terms expressing properties of muds include weight, viscosity, salinity, alkalinity, acidity, thixotropy, settling tendency, and surface tension. Other words used to qualify major properties are: temperature, water separation, filtration properties, slick, thick, fluffy, velvety, texture, natural mud, and synthetic mud. The significance of the major items of this list is the subject-matter of the paper.

The filtration of water from muds under high pressure at great depths, effect of high temperature on viscosity, and the lack of effectiveness of certain treating agents make mud control in deep wells a difficult and exacting task. Under such conditions the filtration rate of water is greatly accelerated and a much thicker wall deposited before the loss of water is stopped than in the case of shallow and less severe conditions. This fact has led to the extensive use of muds rich in colloidal material, having a liberal water content, and composed of mixed particle sizes capable of building a wall rapidly.

Conditioning and practices essential in handling gas are described in detail. A dangerous gas flow is indicated when the viscosity rises sharply, the weight drops, and there is little or no curdling tendency. On the other hand, when the mud shows a strong gelling and curdling tendency, loses weight, and registers an apparent rise in viscosity, a high-pressure salt water has been encountered. Treatments for these cases are outlined.

The complicated problem of regulating weight and preventing loss of circulation, particularly in the so-called "surface" sands, is outlined, together with the usual solutions adopted.

Reduction of viscosity by phosphates is next discussed. The addition of tannic acid to the phosphates helps to make mud more effective when drilling cement. Mud badly cut with cement has been treated effectively with a mixture of bicarbonate of soda and pyrophosphate.

Silicate muds have been effective in drilling caving formations affected by loss of water from ordinary mud.

The significance of *p*H value is briefly explained. A good drilling fluid usually shows a *p*H of about 8·5. In certain bentonitic formations that make mud freely the *p*H may rise to 10; such high alkalinity, however, makes thinning and an increase in the acid content necessary.

The colloidal material in mud begins to flocculate when the *p*H passes 9·5 or 10, although many native muds perform best with a *p*H around 9.

Methods of determining *p*H of muds are outlined. The method of using strips impregnated with dyes sensitive to the *p*H value is given in greater detail than the glass electrode system. A. H. N.

757.* Drilling Contractor Uses Two Charts to Check Well Progress. Anon. *Oil Wkly*, 4.3.40, **96** (13), 30.—Use of detailed and composite drilling progress charts enabled one

drilling company to check and analyse methods, performance of equipment, and mud characteristics with remarkable exactness. Two charts were used.

The first chart contains a sectional well log, casing chart, screen, liner and packer assembly, drilling curve, directional survey, equipment record, and an hourly breakdown of operations.

The second chart listed the various mud characteristics, with the well log shown as the horizontal scale. These characteristics were weight, viscosity, % solids, % sands, *p*H value, and " material added."

The charts showed up mistakes, and thus the efficiency of subsequent drilling was increased and better time was recorded. Marked contrasts or extremes were easily spotted on the charts, and reasons for such differences often forced changes in practice and equipment.

The methods of compiling data for, and construction of, the charts are briefly outlined and their use is described. Actual charts are reproduced on a large scale. A. H. N.

758.* Drilling from Off-Shore Pier Past Experimental Stage. R. H. Tate. *Oil Wkly*, 11.3.40, **97** (1), 20.—The activities of two years of operations during which nine wells have been drilled to completion from the piling-supported structure located 6000 ft. from the shore-line are studied. The structure on which the work was carried out is supported approximately by 550 basic creosoted pilings averaging 60 ft. in length. The depth of water is only 14 ft., despite the great distance from the shore. The structure has withstood the buffeting of wind and wave and proved a complete success.

The outstanding feature of these operations has been the directional drilling involved. The area has been a veritable testing-ground for this method, and, as a result, a number of revelations pertaining to the practice have been made. The chief one of these is that it is cheaper and generally more satisfactory to tear down one location and move equipment to another than drilling several holes from one central point. The wear and tear on the equipment, particularly the drill-pipe, is tremendous. Fishing jobs are greatly complicated. All routine jobs are similarly made more difficult and expensive in directional than in ordinary drilling.

It was proved that the system is cheaper than if a board walk were constructed from the shore, in spite of the fact that a small flotilla had to be maintained under constant charter.

Safety factors against blow-outs and fires resulting therefrom are outlined. Routine jobs are also described. A. H. N.

759.* Test in Swiss Alps Projected to 12,000 ft. Anon. *Oil Wkly*, 18.3.40, **97** (2), 128–129.—A completely electrically equipped wildcat is drilling near Neufchatel, Switzerland. The test, projected to 12,000 ft. if necessary, is on a secondary fold in the Swiss Alps. It started out by taking 12-in. cores, and later was reported taking 6-in. cores consisting chiefly of Jurassic limestone, marble, indurated limestone, and dolomite.

Some oil and gas shows have been reported. A. H. N.

760.* Drilling Runs Higher in 1940 than in 1939. L. J. Logan. *Oil Wkly*, 18.3.40, **97** (2), 228–230.—Although drilling was handicapped greatly by the extremely cold weather of late January and early February throughout most of the U.S.A., the industry so far this year has completed approximately 10% more new wells than it did in the corresponding period in 1939.

Statistics are given in monthly periods from 1933 to February 1940 for the average number of wells completed daily in the U.S.A. Detailed tables are given for the first two months of 1940 for the different states and districts, giving total wells and the numbers of oil, gas, and dry wells found, as well as the initial productions, and these are compared with 1939. A. H. N.

761.* More and Deeper Wells are Being Drilled in 1940. L. J. Logan. *Oil Wkly*, 1.4.40, **97** (4), 16–18.—Data are given for average drilling depths for every year since 1925, and these show an increase for 1940. Tables and charts are reproduced giving number of wells completed each year and footage drilled for the U.S.A. by years, average daily well completions in U.S.A. by months (1933–1940), and number of rigs

in various fields of the States. All these data reveal an increased activity in drilling and completion this year. A. H. N.

762.* Construction of Drilling Platforms for Well Sinking through Rocks which are Covered by Shallow Water at Low Tides. H. Giraldez. *Bol. Inform. Petroleras*, Dec. 1939, XVI (184), 47–56.—This is a well-illustrated article showing the methods adopted for erecting drilling rigs on rocks which are only slightly submerged at low tide. The work consists in building a dyke from the shore to the drilling platform, building up the platform on the rock with concrete blocks and foundation blocks for the rig, and erection of a gantry carrying the various pipe-lines and a gangway, level with the deck from which drilling tackle is operated. H. I. L.

763. Drilling Patents. P. H. Nast. U.S.PP. 2,191,491 and 2,181,492, 27.2.40. Appl. 6.6.35 and 23.7.35, respectively. Drill-bits.

J. L. Reilly. U.S.P. 2,191,493, 27.2.40. Appl. 26.2.36. Drill-bit.

C. L. Deckard. U.S.P. 2,191,643, 27.2.40. Appl. 21.6.38. Tubing handling-board for derricks.

A. C. Hamilton. U.S.P. 2,191,652, 27.2.40. Appl. 12.8.38. Method of sealing earth formations comprising injecting potentially hardenable calcined gypsum.

L. A. Rawson. U.S.P. 2,191,681, 27.2.40. Appl. 21.9.38. Derrick construction.

L. L. Brown. U.S.P. 2,191,750, 27.2.40. Appl. 14.2.38. Well-cementing apparatus for inserting cement around casing.

W. T. Wells. U.S.P. 2,191,783, 27.2.40. Appl. 15.7.39. Bridging plug using metallic exothermic reacting material to flow between body and casing and means for igniting this material.

H. D. Sandstone. U.S.P. 2,192,065, 27.2.40. Appl. 20.9.37. Self-loading and unloading bailer of the hydrostatic pressure type.

H. C. Johansen. U.S.P. 2,192,192, 5.3.40. Appl. 7.7.36. Rotary drilling machine with hydraulically operated pistons to raise and lower the table.

L. C. Symons. U.S.P. 2,192,278, 5.3.40. Appl. 22.3.37. Mud screen.

Z. A. Dyer. U.S.P. 2,192,400, 5.3.40. Appl. 12.10.37. Lower plug for cementing wells.

W. N. Meeks. U.S.P. 2,192,478, 5.3.40. Appl. 4.3.39. Pipe clamp.

J. A. Dunn and W. Elliot. U.S.P. 2,192,584, 5.3.40. Appl. 12.11.38. Rotary drilling apparatus where the prime mover may be connected either to the draw-works or the rotary independently or to the rotary through the draw-works.

L. L. Payne. U.S.P. 2,192,693, 5.3.40. Appl. 7.5.38. Wash-pipe adapted to flush fluid at right angles to teeth of cutter on roller-bit.

F. L. Scott. U.S.P. 2,192,697, 5.3.40. Appl. 27.12.38. Cutter mounting for a roller-bit.

S. D. Rowe. U.S.P. 2,193,010, 12.3.40. Appl. 17.9.38. Safety device for catheads.

H. L. Rymal. U.S.P. 2,193,144, 12.3.40. Appl. 25.5.39. Method and apparatus for forming mud seals on completion of well by forming a gel between casing and tubing at a desired point in the well bottom.

E. V. Watts. U.S.P. 2,193,183, 12.3.40. Appl. 4.4.38. Rod catcher.

C. P. Bowie and R. V. Higgins. U.S.P. 2,193,219, 12.3.40. Appl. 4.1.38. Drilling wells through heaving or sloughing formations using a circulating refrigerating fluid to freeze the formation.

E. K. Cole. U.S.P. 2,193,269, 12.3.40. Appl. 24.1.38. Clamp for guy wire cables.

H. S. Davies. U.S.P. 2,193,862, 19.3.40. Appl. 29.5.39. Inclinometer with a siphon-tube arrangement.

A. R. Bone and A. P. Albrecht. U.S.P. 2,193,917, 19.3.40. Appl. 24.10.38. Bit extension.

W. T. Caldwell. U.S.P. 2,194,066, 19.3.40. Appl. 14.11.38. Drilling apparatus of the portable type.

W. P. Kincaid. U.S.P. 2,194,090, 19.3.40. Appl. 12.10.39. Bit breaker.

G. G. Harrington. U.S.P. 2,194,119, 19.3.40. Appl. 19.7.37. Drill-bit with roller cutters.

A. D. Rhodes. U.S.P. 2,194,124, 19.3.40. Appl. 30.8.38. Derrick base.

J. D. Brock, L. R. Leissler and R. A. Warren. U.S.P. 2,194,267, 19.3.40. Appl. 30.10.39. Drilling tool comprising a stem, a bit, a tiltable joint to rotate the bit, and means in the joint to tilt the joint upon relative turning of bit and stem.

C. E. Strom. U.S.P. 2,194,331, 19.3.40. Appl. 24.5.39. Retrievable wire-line bridge-plug.

L. C. Backer. U.S.P. 2,194,631, 26.3.40. Appl. 5.1.39. Straight-hole drill device.

W. F. Feltenberger. U.S.P. 2,194,647, 26.3.40. Appl. 20.2.39. Cable clamp.

L. L. Sanders and G. C. Street. U.S.P. 2,194,675, 26.3.40. Appl. 5.4.37. Drill-bit with cone cutters.

R. R. Bloss. U.S.P. 2,195,200, 26.3.40. Appl. 1.6.37. Brake for drums.

W. J. Opocensky. U.S.P. 2,195,224, 26.3.40. Appl. 3.5.38. Method of surveying wells and apparatus therefor, consisting of means of measuring rotation of a string of rods raised or lowered in stages into well.

D. Cole. U.S.P. 2,195,445, 2.4.40. Appl. 4.10.37. Pipe elevator.

D. M. Smith. U.S.P. 2,195,501, 2.4.40. Appl. 23.2.37. Rotary swivel.

W. A. Curtis. U.S.P. 2,195,530, 2.4.40. Appl. 17.6.39. Thread protector for pipes and casings.

F. D. Snell. U.S.P. 2,195,586, 2.4.40. Appl. 29.2.36. Acid and waterproof cement.

J. W. O'Brien. U.S.P. 2,195,752, 2.4.40. Appl. 18.1.37. Well drilling mud condition and method of maintaining a supply of conditioning agent near the bit and gradually feeding the agent into the mud.

P. H. Jones and A. L. Blount. U.S.P. 2,195,798, 2.4.40. Appl. 20.10.36. Drilling fluid adapted to determination of degree of contamination of core sample by utilizing nicotine in solution.

D. O. Newton. U.S.P. 2,195,898, 2.4.40. Appl. 23.8.38. Apparatus for degassing rotary muds by means of a vacuum tower.

M. Davis, J. E. Lacy, and A. C. Andrews. U.S.P. 2,196,141, 2.4.40. Appl. 25.9.39. Pipe rotating device. A. H. N.

Production.

764.* Experimental Plant at Cotton Valley Proves Recycling to be Feasible. G. Weber. *Oil Gas J.*, 7.3.40, **38** (43), 32–33.—The Cotton Valley field comprises one of the most

outstanding gas-condensate reserves thus far discovered. Extensive field tests have been conducted to find out the possibilities of a recycling project. Two high-pressure separators, a 600-h.p. compressor, and high-pressure lines connecting the unit to two producing wells and one injection well comprise the experimental plant.

Conclusions reached from experiments are: (1) pressures required for injection are of such magnitude as to be economical; (2) design of the production-scale plant should be governed by the type and quantity of a readily marketable product; (3) considering the apparently high super-compressibility of the gas in question, the cost of the compression equipment will be well within the original estimates.

In summarizing, it may be said that this test operation has served its purpose by determining the volume–pressure relationship in a test well. Using data furnished by this test, it has been possible to estimate equipment requirements and to define engineering and economic features which are of vital importance in planning a project for developing a gas-condensate reserve.

The procedure and other results of the test are given. A. H. N.

765.* Some Unsolved Deep Well Problems under Proration. G. O. Nevitt. *Oil Gas J.*, 7.3.40, **38** (43), 43.—The conclusions reached from the discussion in the paper are: most deep wells are being drilled and completed by using the most advanced machines and methods, but they are being produced by methods of many years ago.

Many deep wells have produced but a small quantity of the oil actually in place adjacent to the well bore, before going completely to salt water or to excessive gas–oil ratios.

Workovers to control salt-water encroachment or excessively high gas–oil ratios in deep wells have not been entirely successful.

Wells to be drilled between present locations, or the use of more efficient production methods, or both, will have to be used to get all possible recoverable oil from deep formations.

Workable formulas for determining what constitutes the optimum rates of flow of oil and gas from wells, particularly deep wells, have yet to be developed. There is at present more agreement among engineers than among oil executives that such formulæ are the basis for the whole conservation and proration structure. A. H. N.

766.* Rod-Line Crossings for Producing Properties. P. Reed. *Oil Gas J.*, 7.3.40, **38** (43), 48.—In devising methods for providing road-crossings for rod-lines at oil-producing properties pumped by central powers, operators have applied much ingenuity in solving the problems presented by conditions in different localities. Photographs and descriptions give some of these methods. Most crossings are made by passing the rod-line under the highway through a casing, and it is frequently necessary to instal a pendulum of some kind to transmit the motion of a rod-line on the surface to a lower level. A. H. N.

767.* Pressure Maintenance (Cunningham–Lansing Lime Pool, Kansas). C. C. Rae. *Oil Gas J.*, 14.3.40, **38** (44), 42–43.—*Paper presented before American Petroleum Institute.* Many wells in this pool would now be unprofitable and ready for abandonment without pressure maintenance. The past oil production has been about 2,000,000 brl., of which 1,009,000 brl. were produced prior to pressure maintenance. The normal ultimate oil production can be estimated at 2,800,000 brl. without pressure maintenance. The total volume of gas input has been 84% by volume of the gas produced. An ultimate oil recovery of 5,200,000 brl. is promised under pressure maintenance. This result offers considerable encouragement for other pressure-maintenance projects in the same formations. Results will probably vary with permeability and regularity of the pay zones. It is usually very difficult to consolidate the ownership of oil leases under one operator, which would be necessary to justify the erection of a gasoline or a recycling plant, and begin pressure maintenance early in the life of the pools, when larger volumes of gas are available than would be the case later. A. H. N.

768.* Improved Pumping Operations in Central Power Units. G. Weber. *Oil Gas J.*, 14.3.40, **38** (44), 45.—Design and balancing of central-power pumping units require application of many engineering principles, not only during the original installation

work, but also during their operational period, as changing field conditions call for periodic checks to minimize equipment wear and economize on power.

A case in East Texas is studied in particular, as there the problem of keeping central powers in good condition is particularly important. Declining pressures, and in some cases salt-water encroachment, vary individual well loads and necessitate addition of wells which were flowing when the power was first installed.

In this particular case the power was overloaded and out of balance. It was necessary to improve its operation to care for additional wells due to go on the pump, and to reduce power loss and equipment wear. Dynamometers were used in weighing each well at a point on the rod-line immediately adjacent to the power. From the data on the individual cards the amount of force and its direction were computed on the basis of current pumping schedules. From that point proposed pumping schedules which gave better balance were assumed and, by trial and error, the proper counterbalances were determined. Specimen calculations are given in the paper.

As a result, as shown by two representative schedules, the maximum horse-power requirement of the unit was cut from 107 in the old schedule to 43 in the new one. Excessive wear of the gears on the heavy side of the power was halted, and the oil leak in the power due to loosening of the trunnion flange was stopped. A. H. N.

769.* Treatment and Disposal of Oil-field Brines. J. J. Rady. *Oil Gas J.*, 14.3.40, **38** (44), 48.—To solve the problem of disposing of oil-field brines the scientific approach is recommended, requiring a study of the fundamental principles involved and careful examination of all previous work done on the subject. Oil-field brines contain more dissolved salts than are found in sea-water. Some brines contain small quantities of relatively rare salts, and attempts are being made to recover these as a part of the brine-treating and disposal process. Salt and gas contents of the brines generally found are briefly discussed.

The effects of brine on fish life are similarly briefly studied. This effect is a function of concentration. The most vital consideration is the effect of brines on public and private water supplies. Chlorides are limited to 250 p.p.m., magnesium to 100 p.p.m., and total solids to 1000 p.p.m.

There are three general methods of disposal of oil-field brines. The first is to impound the brine in evaporation ponds; the second is to divert the brine into a surface stream; the third method involves the return of the oil-field brines to subsurface formations.

Each of these methods has its own advantages and inherent drawbacks. These are discussed under each system. The third system is treated with greater detail, particularly with regard to the essential need of conditioning the brine prior to disposal.

There are two general systems for treating brines to make them fit for subsurface disposal. The closed-type system allows for complete removal of suspended matter, but permits retention of other components in permanent solution of the brine. In the other, the open-type system, all suspended matter, as well as all components that might become suspended, are removed before subsurface injection of the brine. The second system requires five definite steps: (1) separation of oil from the brine; (2) aeration for the removal of carbon dioxide and hydrogen sulphide; (3) stabilization of carbonate components by intimate contact of the brine with calcium carbonate sludge and the like; (4) reduction of dissolved oxygen in the brine; and (5) filtration of suspended matter. A. H. N.

770.* Gasoline Recovery Devices Tested on Stripper Lease. P. Reed. *Oil Gas J.*, 14.3.40, **38** (44), 53.—For the purpose of determining the practical value of low-cost methods for recovering small quantities of gasoline in connection with the operation of an oil-producing property which has reached the stripper stage, tests are being conducted using materials of the kind available on any lease. Experiments on refrigeration equipment connected with stripping are also being made.

The paper is a short description of the tests and the equipment. Gasoline recovered by this unit is sold with the crude, thus adding to the production of the property as well as raising the price of the crude. A. H. N.

771.* Metals in Production—Strainers, Tubing, and Valves. W. L. Nelson. *Oil Gas J.*, 14.3.40, **38** (44), 56.—The properties required of and the specifications for metals to

be used in strainers, tubing, and valves for oil production are briefly discussed. A table gives the chemical composition (C, Mn, Ni, Cr, Mo, and " others "), yield point, elongation, Brinell hardness, and suggested heat-treatments for metals in stems and seats, valve boltings and bodies, blow-out preventers, casing, and tubing. Seven references are appended. A. H. N.

772.* **Catenary Suspension Increases Rod-Line Efficiency.** H. F. Simons. *Oil Gas J.*, 21.3.40, **38** (45), 42–43.—More extensive use of dynamometers for testing pull-rod-line efficiency has led to the re-examination of the friction losses between the centrally located geared power and the pumping-jack and the remodelling of the pull-rod line to reduce horse-power requirements. It has been known that the catenary suspension of pull-rod lines traversing rough terrain was more efficient than trying to establish straight pull. This was evidenced by an increase in the number of wells which could be pumped by a geared or band-wheel power with pull-rods suspended in this manner over the number of wells which could be pulled when using a straight rod-line. Theoretically the catenary suspension was more efficient; this paper gives quantitative measure of the saving.

Normal loss between geared power and the pump-jack amounts to 3·5–5·0 h.p./1000 ft. of rod-line where the rod-lines are of straight-line construction. By taking advantage of the catenary effect in the construction of the rod-line, using hold-ups and rollers at the appropriate points, and still doll-heads for supports, the power loss can be reduced to 0·85–1·25 h.p./1000 ft. of rod-line traversing gently rolling ground and 2·25–2·50 h.p. over rough terrain. Savings in costs are indicated and the equation for the catenary curve is given for purposes of calculating the necessary sags in feet. A. H. N.

773.* **Positive Displacement Oil Meters in Production Work.** L. R. Van Arsdale. *Oil Gas J.*, 21.3.40, **38** (45), 44.—*Paper presented before American Institute.* Dissolved gas and entrained gas are the important factors in making installation of the meter through the various stages in the life of the field. Conditions of high temperatures, high pressures, and corrosives are problems which must be handled in the manufacture of the meter. The manufacturer must also produce a meter which will have very little variation in measurement with changes in viscosity or from normal wear. Meters meeting these conditions have been designed and are on the market, giving good operation for long periods of time without necessity of calibration or repair. However, it should be remembered that the positive displacement meter operates under severe conditions at the best. Bearings receive no lubrication except from the liquid passing through the line, and they are subjected to the abrasives contained in the liquid. As is the case with any piece of mechanical equipment, speed of operation is an important factor with regard to rate of wear.

The economies of metering are not only dependent on good design and manufacture, but also on proper operation and maintenance. A. H. N.

774.* **Load and Power Needs of East Texas Wells.** G. Weber. *Oil Gas J.*, 21.3.40, **38** (45), 52.—Tabulated data and a discussion are given for forty-two wells in East Texas. The well data comprise pump-bore, rod-string size and length, strokes/min., stroke length, barrels of fluid lifted/hr., dynamometer loads for maximum and minimum values, calculated maximum load, average horse-power, and peak horse-power. The data show a wide variety of combination of pump and rod size, pump depth, speed, length of stroke, and fluid lifted.

The survey shows that actual loads are substantially less than calculated loads, using the established formula derived from A.P.I. specifications. A. H. N.

775.* **Some Practical Aspects of Water Flooding.** L. C. Converse and R. R. Hawkins. *Oil Gas J.*, 21.3.40, **38** (45), 54.—*Paper presented before American Petroleum Institute.* The paper opens by giving statistics of flooding operations in two States of America. For analytical purposes floods which were started prior to 1938 only are considered, as there is sufficient background to estimate fairly accurately the total amount of oil each will make. Comparisons are made between Oklahoma and Kansas operations.

The reasons for comparative early failure of flooding in these two States are discussed. Lack of experience appears to be the major cause.

Some of the specific causes of failure, which again come back to lack of experience, are: (1) too low saturation; (2) channelling by previous air-repressuring operations; (3) too wide spacing for the viscosity found; (4) too high and improper setting of packers in input wells; and (5) failure to use proper pressures. These five items are discussed in detail.

Graphs are given in an attempt to answer the question of how low a recovery per acre can be successfully flooded. Using set conditions of permeability, viscosity, pressure, and time, the first graph shows spacing *vs.* depth under flowing conditions. A second figure gives the maximum amount of oil which must be recovered under these conditions to break even with oil at $1/brl. The method and characteristics of the graphs are detailed. A. H. N.

776.* Plugging Off Bottom-Hole Water in Arbuckle Lime Horizon. J. N. Miles. *Oil Gas J.*, 21.3.40, **38** (45), 57–58.—*Paper presented before American Petroleum Institute.* The conclusions reached of the recent developments in the method of plugging off bottom-hole water in Arbuckle lime are :—

(1) Salt-water encroachment can be controlled in three ways: (*a*) By amount of penetration of producing formation; (*b*) by rate of fluid withdrawal; and (*c*) by remedial work such as water shut-offs.

(2) Acid appears to be essential in shut-off work in Arbuckle lime to open the formation for penetration of cement.

(3) Wells with greater amounts of penetration and hard strata between pay-zones offer greater chances of success.

(4) Indications are that the acid reaction will take place in the water-zone in preference to the oil-zone if given an equal opportunity, and, by the same token, cement will enter the water-zone in preference to the oil-zone.

(5) One of the most attractive features of this type of job is its lower cost.

(6) The amount of success will depend largely on the care of application and the experience of the operator. A. H. N.

777.* Metals in Production—Oil-Well Pumps. W. L. Nelson. *Oil Gas J.*, 21.3.40, **38** (45), 62.—The requirements of metals used in pumping equipment are discussed. The parts that are subject to the most severe conditions are the balls and seats of valves, pump barrels, pump plungers, pump liners, and the cages or crowns which contain the valves. The types of steels employed in various parts to minimize wear are given in brief.

A table recommends special materials to be used in oil-pump barrels and plungers, valve cages or crowns, and liners, and gives the per cent. composition (C, Mn, Ni, Cr, Mo, "others"), Brinell hardness, and certain notes on their specialized properties such as "corrosion resistant," "wear resistant," etc. Eleven references are appended. A. H. N.

778.* Devonian Well Production Decreases Rapidly. J. McIntyre. *Oil Gas J.*, 4.4.40, **38** (47), 13.—Statistical data are given for the production per well as well as for the whole field in Devonian lime in Illinois. Over-drilling is thought to be the cause of decline in production. A. H. N.

779.* Full-Scale Pressure Maintenance Under Way in K.M.A. Field. D. H. Stormont. *Oil Gas J.*, 4.4.40, **38** (47), 34.—The paper describes a co-operative project which started about a year ago, and which has now reached a stage where field-wide operations are under way. When the remaining preliminaries are completed, all available gas will be processed in the field's five natural gasoline and recycling plants, and after being compressed to pressures ranging from 1200 to 1800 lb./sq. in., the residue will be returned to 100 or more input wells in the field.

Detailed charts and discussions illustrate the principles used and the operations necessary. The method of determining the correct quantity of gas to be injected is given, as well as other necessary tests. A. H. N.

780.* Gravel-Packing Oil-Wells in Gulf Coast Fields. M. L. Cashion and F. B. Markle. *Oil Gas J.*, 4.4.40, **38** (47), 48.—*Paper presented before American Petroleum Institute.* Gravel-packing has been used for many years in completing water-wells, but it has

been applied to oil-wells only in recent years. As the first oil-wells were gravel-packed successfully in the Gulf Coast area, this paper is a brief history of gravel-packing, with descriptions of methods and equipment developed and used in the Gulf Coast.

Gravel has been extruded successfully through perforated casing to fill the cavities formed by the production of sand. Although gravel-packing has been applied primarily to producing oil- and gas-wells, it has been used also in recycling wells, with excellent results. A. H. N.

781.* Revised Completion Method. E. S. Post. *Oil Wkly*, 4.3.40, **96** (13), 22–24.—The first well to be finished under the revised methods, which consist of the use of oil as a circulating medium, drilling-in under pressure and acidizing, flowed at the rate of 895·56 brl. of pipe-line oil per day through 1-in. choke. Several weeks after its completion, the test was maintaining its flow and pressure, suggesting that the output will be sustained, although it was situated between several previously completed wells which failed to do so. The producing formation is the Austin chalk.

The full circulation of oil while drilling caused the chalk cuttings to be removed readily and not dissolved to wall up the face of the hole. It is believed that the low permeability of the chalk-producing horizon is lessened to nil by drilling mud, or by the paste created in dilution of the formation itself.

A sectional elevation is given of the special christmas tree installed, which was fitted with ram-type stuffing-box which acted as a preventer and an oil saver while drilling. Details of operations are also included. A. H. N.

782.* Derrick on Wheels Services Five Wells. Anon. *Oil Wkly*, 4.3.40, **96** (13), 26.—A derrick has been equipped with small wheels, enabling it to be pulled along rails and be spotted over any one of five closely spaced pumping wells. Small cable winches or reels, each fitted with a double handle for two-man operation and mounted on pieces of upright anchored casing, easily pull the derrick to any desired position when a well has to be worked on. The rails are embedded in the concrete flooring that is common to the five wells. A. H. N.

783.* Distribution of Allowables in East Texas Field. I. I. Gardescu. *Oil Wkly*, 11.3.40, **97** (1), 10–11.—An attempt is made to answer the question: "On what basis should production be distributed among the wells in East Texas if the allocation problem is confined to the legal rights of oil ownership?"

Legal rights of oil ownership are summarized under four headings, and their aspects and influence on production rates of wells and fields are discussed.

Allocation of production under a simple plan is outlined. In this plan present daily allowable of the western marginal wells will be increased to about twenty-three brl. and up. The wells to the east will receive somewhat less than their present allowable, but their ultimate recovery will be greater than the computed volume of recoverable oil in place.

The leases and wells in the fairway will receive a share of the oil that will be as nearly as possible equivalent to their reserve of recoverable oil. A. H. N.

784.* Principles Underlying Equitable Withdrawals of Oil. S. F. Shaw. *Oil Wkly*, 11.3.40, **97** (1), 12–18.—The most contentious phase of the subject is that of the quantity of oil which may be produced from a given well. The methods of withdrawals should not be such as to allow one operator to withdraw much greater percentages of his recoverable oil during a given period than an adjacent operator, since this tends to lower the pressure in the area heavily produced to a lower point than in the nearby sector, and thereby causes oil in the adjacent property to flow into the area where production is proceeding at a high rate.

The statement often made that the law of capture is inequitable is discussed. It is shown that this rule or principle of capture still exists, and will continue to exist, regardless of statutes enacted to prevent or to modify its operations. Many cases are cited in detail where it is impossible to prevent the operation of this principle. This is because it is impossible to enact and enforce a law limiting the oil that an operator produces under any and all conditions to only that portion lying under his acreage.

Oil and gas will always tend to flow towards a property where a lower pressure exists than in the place they happen to be.

The quantity of oil in a reservoir, usually considerably greater than that which will be recovered, depends on several factors, the most important of which are :—

(1) thickness of the producing formation ;
(2) porosity of the producing formation ;
(3) percentage of saturation of the formation ;
(4) percentage of the producing formation occupied by oil, gas, and water.

Recoverable contents depend on the four factors mentioned, and

(5) pressure in the reservoir, principally a factor of depth ;
(6) permeability of the formation ;
(7) economics.

The complex inter-dependence of these factors and the way they affect the recoverable quantity of the oil in a reservoir are discussed. Methods of measuring well potentials are critically reviewed and compared for accuracy and equity. Well-spacing problems are analyzed with a view to obtaining optimum recovery values.

Finally, methods employed for establishing daily allowables when operations are curtailed are reviewed and a new method is suggested. This method, briefly, is to calculate the square root of the acreage allotted to each well and multiply this factor by the twenty-four-hour potential of the well, thus arriving at the well factor. The method is illustrated by an example. A. H. N.

785.* Shock Absorbers for Oil Well Shooting. J. R. Cozzens. *Oil Wkly*, 11.3.40, **97** (1), 35.—In many cases of shooting wells, the wells fail to respond to the effects of the shots in terms of increased production. After many tests it has been proved that a cause for such failure is the sand-breaking at the bottom of the well, thus allowing fluid to escape through the shales underneath. The damage can be remedied by the use of concrete ; but prevention of its happening is the best course to follow.

To prevent breaking up of the lower formations a shock absorber is placed below the charge. This is of about 3 to 6 ft. of short-fibred asbestos or rockwood insulation material placed in a pocket drilled at the bottom of the well and tamped heavily from bottom to top. The tamping is done by means of a shield placed over the cutting edge of a drill bit.

This comparatively small quantity of shock absorber has been found sufficient to break the rhythmical vibrations at firing time, and to minimize the effects of the downward force of the blast. Stray fibres are removed by suction bailing during the cleaning-out process, and do not interfere in pumping the well. A. H. N.

786.* 1940 World Production Likely to Exceed '39 Peak. L. J. Logan. *Oil Wkly*, 18.3.40, **97** (2), 47–49.—Analysis of world crude production is made and certain forecasts are presented for 1940. A chart gives the distribution of world production in 1939 for different continents and countries. A. H. N.

787.* Production and Drilling Gains Spur Canada. Anon. *Oil Wkly*, 18.3.40, **97** (2), 164.—A study of production and drilling activities in Canada in recent years is made in this, one of many papers in the international number dealing with similar problems all over the world. A. H. N.

788.* Taking the Pulse of the Pumping Well. D. O. Johnson. *Oil Wkly*, 25.3.40, **97** (3), 19 ; also *Oil Gas J.*, 21.3.40, **38** (45), 46.—*Paper presented before the American Petroleum Institute.* Taking the pulse of the pumping well offers a procedure for materially reducing pumping costs on many operations. In planning such efforts, well studies should first be classified as to purpose, that is, as to whether the problem is to eliminate equipment failures, to improve efficiency, or to gather important data useful as a guide in the selection of new equipment. Consideration should then be given to the type of well to be dealt with so that limitation may be better defined. This means knowing whether the well is operating to the capacity of the equipment, or to the capacity of the well, or whether it is prorated.

When interpreting the dynamometer card in such work it should be borne in mind

that the load recorded is really the dead-weight load plus or minus the relative acceleration of the hanger and polished rod, and that acceleration forces can come from the stored energy in rod-strings as well as from the hanger. This principle explains many peculiar cards and allows a further exploitation of the information dynamometer cards contain, to effect improved pumping results. Mature experience in this type of work indicates that there is a large field for its further expansion, and that what we know to-day is only a forerunner of to-morrow's possibilities, and that the original method of lifting oil, although it has undergone much improvement, can still further be improved to meet pumping conditions and the need for lower pumping costs.

The paper is generously illustrated by figures of dynamometer cards and their interpretations. A. H. N.

789.* Gun Perforations and Acidization in Open Formation of the Limestone Pays in the Peruvian Basin. J. A. Jones. *Oil Wkly*, 1.4.40, **97** (4), 19–21.—*Paper presented before American Petroleum Institute.* It is stated that in most wells in the area under discussion there is a very thick producing zone with great variation in saturation, porosity, permeability, and density between the top and bottom of each zone, and that any type of completion in such wells that involves the section as a whole may not give the best results.

Selective gun perforations of the saturated zones, according to the formation variations as indicated by cores or drilling rate curves—concentration of shots in the more dense sections—greatly increase the surface exposed to acid action. The channels and crevices created by the bullets affect the permeability factor by connecting the separated pore spaces and giving increased outlets to the bore.

Acid treatment following gun perforations has given excellent results in increasing the potentials and rates of recovery in a high percentage of the wells to which this technique has been applied. The author explains the method and includes tables and comparisons of results obtained on sixteen typical wells. A. H. N.

790.* Locating and Counterbalancing Central Pumping Powers. S. J. Pirson. *Oil Wkly*, 1.4.40, **97** (4), 28.—Attention is focused in this long paper on the application of dynamometer cards to the study of central pumping power problems, and particularly to the application to the reduction of pumping costs by permitting a reduction to a minimum of the necessary prime-mover powers. The method used is to solve the following problem, graphically and in a complete manner: "Being given the lease lay-out, represented by a figure, and having five wells, A, B, C, D, E, individually pumped and for which the individual dynamometer cards are given by other figures, it is desired to replace the individual pumping units by a central power whose location and counterbalance for minimum power consumption is to be determined."

To obtain the satisfactory location, a method of successive approximations is used and the location is found in two steps. This point being found in the first half of the paper, the loads of the wells are balanced against each other and the off-balance power is determined, and finally a counter-balance load is located to bring all the loads into balance. A. H. N.

791.* Factors that Determine Profitable Secondary Recovery. R. T. Zook. *Petrol. Engr*, March 1940, **11** (6), 23–26.—The paper is an informal and detailed discussion on the procedure and various observations involved in appraising the factors that determine profitable secondary recovery. It deals more particularly with water-flooding operations.

Typical values for costs encountered in water-flooding, in terms of cents/brl. of water pumped in and of oil recovered, etc., are given. An average cost in Pennsylvania in operating 1800 wells at an average depth of 1600 ft. has been, over a period of ten years, 37 cents/brl., exclusive of taxes and overhead charges. The balance of cost of operation against profits is given for various cases.

Coring, its cost per foot, types of bits used, and the information to be gained therefrom are detailed. Porosity, permeability, oil and water saturation are discussed and their significance in water-flooding is illustrated by reference to typical examples in accepted practice. The variation in permeability of the sand is of particular importance, and extensive coring is advocated in order to be in a position of obtaining optimum values from flooding or other secondary recovery operations. Typical cases

of sands with streaks of high and low permeabilities are discussed. Where the soft streak is between two hard streaks, the use of compressed air to create "Jamin" action has been found definitely helpful.

The theoretical bottom-hole pressure possible to use for water is 1 lb./ft. of depth. In practice, twice this amount is permissible. Greater pressures appear to lift the crust of the earth, creating a crevice in which the water passes instead of going through the sand. On release of pressure the strata subsides to the original level.

A discussion of the requirements of pressure equipment and well spacings then follows. Development costs and the great importance of coring and organizing research work form the concluding part. A. H. N.

792.* Zinc Guides Reduce Electrolytic Pitting in Sucker Rods. H. L. Flood. *Petrol. Engr*, March 1940, **11** (6), 31–32.—Tests of zinc rod guides are being made in West Texas with the view of eliminating sucker rod breakages, or at least reducing their frequency. Moulded on the rods at intervals as guides, the zinc serves to "feed" the current rather than permit the discharge of current from and the resultant pitting to occur in the steel itself.

In the tests it was observed that (1) the zinc should be pure, and (2) the behaviour and condition of the zinc guides should be studied closely by pulling the rods frequently. Two precautions were found necessary: (1) The rod surface must be clean to insure a satisfactory contact between the zinc and steel, and (2) the rod and mould must be preheated.

The results show that the process is worth while continuing, but only as a last resort in wells giving the maximum amount of trouble. It is also concluded that frequent inspection is essential, even in the apparent absence of troubles.

A graph of rod-break frequency in one well is given for rods with and without zinc guides. The average number of days the rods were operated was about four times as great for the former case as for rods without zinc guides for all break numbers from 1 to 11. A. H. N.

793.* Fundamental Phase Behaviour of Hydrocarbons. J. E. Sherborne. *Petrol. Tech.*, Feb. 1940, A.I.M.M.E. Tech. Pub. No. 1152, 1–15.—The phase rule is discussed for a one-component system and extension is made to a pressure–temperature–specific volume diagram. In general only liquid, liquid–vapour, and vapour phases need be investigated in considering hydrocarbon reservoir systems. For a two-component system the phase rule shows that it is possible for four phases to co-exist, but no case has yet been found of more than two liquid phases co-existing. The discussion here is limited to systems with only one liquid phase, although the production of oil from deeper zones of higher pressure and temperature may disclose the co-existence of two or more liquid phases. In a reservoir hydrocarbon systems are considered to consist of varying mixtures of the component natural gas and the component crude oil. The pressure–temperature–composition diagram is examined for a two-component system with only one liquid phase, and the significance of dew- and bubble-points are indicated. The conditions obtaining in production are discussed in the light of these equilibrium diagrams. G. D. H.

794.* Disposal of Salt Water in the East Texas Field. A. S. Rhea and E. B. Miller. *Petrol. Tech.*, Feb. 1940, A.I.M.M.E., Tech. Pub. No. 1151, 1–10.—Some 200,000 brl. of salt water/day are produced in the East Texas field, and it is expected that the amount will eventually rise to 700,000. In the early days some water was disposed of by surface methods, but they were not satisfactory. By returning water to the Woodbine sand pressure is maintained, and in the absence of plugging material and if average permeability is encountered, it is unnecessary to use extraneous pressure for water injection.

As a protection to surrounding production water is injected at a point below the oil–water contact and below a shale break or other impervious barrier to prevent upward migration. In the first disposal plant the closed system was used, but proved impracticable. Tests showed that chemical treatment of the water was necessary, and the open system was adopted. The iron content must be reduced to a negligible figure and bacteria must be eliminated. The aerated water is corrosive, and hence all iron and steel must be protected. Care must be taken in completing injection wells.

The disposal of salt water by injection seems economically possible, but the data are insufficient to determine the cost/brl. yet. G. D. H.

795.* Gas Injection at Loudon, Illinois. R. J. Sullivan. *Petrol. Tech.*, Feb. 1940, A.I.M.M.E. Tech. Pub. No. 1173, 1–15.—The Loudon pool on the western rim of the Illinois Basin's deeper part is 15 ml. long and 3½ ml. wide. Three horizons—Weiler sandstone at 1390 ft., Paint Creek sand at 1460 ft., and Benoist or Bethel at 1500 ft.—in the Chester (Mississippi) series are productive. There are wide variations in the permeability, porosity, and thickness of the sands. The pool is generally anticlinal.

The history of the development and production of the pool is given. 25% of the wells still flow. Gas injection has been adopted on some properties to supplement natural energy, so as to drive underground oil while it is in its most fluid state, to avoid at the same time the drilling of unnecessary and even harmful wells, and to conserve and process a meagre gas supply before it has been dissipated. Pressure decline is expected to be rapid. Well spacing ranges from 5 or 6/acre to 1 to 20 acres where gas injection can be applied.

Gasoline is removed from the gas and the latter is then compressed to 750 lb./in.². Data are given of the volumes injected, pressures, etc., and there are gas potential maps. The best results are obtained in regions of high sand permeability. The results to date are encouraging, and no channelling has been encountered. G. D. H.

796.* Recent Changes in California Voluntary Oil-curtailment Methods. J. Jensen. *Petrol. Tech.*, Feb. 1940, A.I.M.M.E. Tech. Pub. No. 1153, 1–13.—The formula now applied in California establishes the allotment for all wells by giving consideration to three items only: (1) A graduated minimum allotment based on the depth of the well; (2) a remaining allotment derived by applying a power factor to the potential of the well remaining above its minimum allotment; (3) a top allotment for the larger wells which varies according to the demand for oil or the outlet for oil that is produced. The first item recognizes the increase in drilling and pumping costs for deep wells. This item is fixed, but the others are varied from time to time according to conditions. The total lease allotment is the sum of the individual well allotments, and may be produced as the operator pleases so long as he does not produce in a way offensive to his neighbours.

Oil curtailment would be relatively simple if it were not necessary for the old wells to give up allotment to permit the new wells to produce. The new formula has ameliorated this problem to some extent. It applies the burden uniformly and there are no favourites. G. D. H.

797.* Government Oil-field at Tupungato, Mendoza. Anon. *Bol. Inform. Petroleras*, Dec. 1939, XVI (184), 3–4).—The last of the four wells, T.19, T.20, T.21, and T.22, which only came into production in October 1939 with an output of 939 m.³, produced in November the large quantity of 10,690 m.³ at a depth of 2048 m. Total output for 1939 up to November came to 106,494 m.³, with the result that owing to lack both of sufficient transport and storage space, the output has to be restricted. H. I. L.

798. Application of Well-Test Data to the Study of a Specific Gas-Production Problem. M. A. Schellhardt, U. J. Dewees, and W. H. Barlow. U.S. Bureau of Mines: *Report of Investigations No.* 3493, March 1940.—The Lone Star Gasoline Company's A. Jones No. 1 gas well in the Sumrall Survey, Buffalo Field, Texas, was completed in 1934, and subsequently showed an abnormal decline in shut-in pressure during a period when a negligible volume of gas was being withdrawn from the reservoir. The only other well in the southern part of the field (A. Beggs No. 1) which was believed to produce from the same reservoir showed no such unaccounted-for decline during the period of reduced pressure in the Jones well. It was, therefore, considered probable that subsurface leakage from the casing or, alternatively, migration of gas from the reservoir to shallower porous strata through channels outside the casing were responsible for the decline in Jones No. 1 well. A study of conditions in this well was conducted under a co-operative agreement between the Bureau of Mines and the American Gas Association. The first part of the investigation included recordings of subsurface temperatures when wellhead connections were closed, and confirmed that gas was

migrating into a shallower stratum at about 2200 ft. below derrick-floor datum. Surface and subsurface pressures, temperatures, and fluid recoveries under different operating conditions in the Jones well were subsequently compared with those of the Beggs well. The report embodies the data obtained from these investigations, and illustrates in particular the value of subsurface temperature data in the study of subsurface leakage from gas wells. H. B. M.

799. Production Patents. A. L. Parker. U.S.P. 2,191,582, 27.2.40. Appl. 8.6.37. Tube coupling.

A. S. Gould, W. M. Emery, and R. E. Hyde. U.S.P. 2,191,692, 27.2.40. Appl. 16.3.39. Pipe-line working tool for cutting and threading pipe.

R. W. Lohman. U.S.P. 2,191,765, 27.2.40. Appl. 2.7.38. Temperature indicator for wells using a helical resistance coil which changes its resistance with change in temperature.

G. F. Turechek. U.S.P. 2,191,781, 27.2.40. Appl. 26.4.39. Pressure compensator for gun perforators.

K. Koller. U.S.P. 2,192,011, 27.2.40. Appl. 30.6.37. Apparatus for preventing condensation in gas mains using a burner which draws gas from the line, burns it, and returns hot products of combustion into mains.

W. C. Nalley. U.S.P. 2,192,236, 5.3.40. Appl. 27.12.38. Well flowing device and method of packing off space between an upper gas sand and a lower oil sand and then using the gas to produce the oil.

C. W. Thornhill. U.S.P. 2,192,336, 5.3.40. Appl. 19.7.37. Screen packer.

P. C. Norman and K. C. Norman. U.S.P. 2,192,480, 5.3.40. Appl. 13.1.38. Apparatus for raising liquids from wells by an air lift pump and a non-return valve.

L. Bryan. U.S.P. 2,192,484, 5.3.40. Appl. 24.10.38. Pipe coupler.

G. E. Szekely. U.S.P. 2,192,565, 5.3.40. Appl. 6.4.38. Threaded follower pipe joint or fitting.

F. I. Alexander. U.S.P. 2,192,591, 5.3.40. Appl. 13.9.38. Casing perforating gun.

L. M. C. Seamark. U.S.P. 2,192,805, 5.3.40. Appl. 18.3.36. Casing-head equipment for bore-holes or wells.

H. R. Toney. U.S.P. 2,192,945, 12.3.40. Appl. 15.8.38. Oil well bottom release valve.

H. D. Collins. U.S.P. 2,193,020, 12.3.40. Appl. 14.2.38. Fluid pump construction.

K. T. Penick. U.S.P. 2,193,110, 12.3.40. Appl. 7.9.38. Blow-out preventer.

G. W. Walker. U.S.P. 2,193,150, 12.3.40. Appl. 19.8.37. Double acting pump for wells.

E. L. Wheless. U.S.P. 2,193,309, 12.3.40. Appl. 29.8.35. Method and apparatus for flowing high-pressure gas wells in which gas is suddenly expanded to freeze its water content and then melting and draining the water so formed.

P. Lazarides. U.S.P. 2,193,426, 12.3.40. Appl. 12.7.38. Pipe clamp.

J. C. Fortune and W. R. Walne. U.S.P. 2,193,587, 12.3.40. Appl. 2.1.37. Stuffing-box and tool joint combination.

E. J. Basye. U.S.P. 2,193,668, 12.3.40. Appl. 23.5.39. Apparatus for operating a well cable one end of which is connected to a work load in the well and the other to a counter-balancing weight. A reciprocating motion is imparted to the cable.

W. M. Stratford. U.S.P. 2,193,775, 12.3.40. Appl. 18.6.38. Method of treating a well on completion with a gravel pack by mixing metal carbonate with the gravel and subsequently dissolving the carbonate.

F. L. Dieterich. U.S.PP. 2,193,807 and 2,193,808, 19.3.40. Appl. 4.1.38 and 27.7.38. Cementing practice for earth wells wherein portland cement and calcium carbonate are used, the latter to be partially destroyed by acid subsequently and form a porous material.

F. H. Hehemann. U.S.P. 2,193,922, 19.3.40. Appl. 15.11.37. Valve and flexible gate.

V. H. Gilliland and J. J. Graham. U.S.P. 2,194,017, 19.3.40. Appl. 24.10.36. Apparatus for producing oil, comprising a pump with a gas anchor in which oil and gas are intimately mixed.

B. H. Scott. U.S.P. 2,194,154, 19.3.40. Appl. 22.7.35. Deep well pump.

N. Johnston and R. V. Quinn. U.S.P. 2,194,229, 19.3.40. Appl. 15.10.38. Apparatus for examining a well casing magnetically.

W. E. King and J. S. Abercrombie. U.S.P. 2,194,254, 19.3.40. Appl. 14.1.29. Pressure equalizer for blow-out preventers.

H. Allen. U.S.P. 2,194,255, 19.3.40. Appl. 4.2.36. Blow-out preventer.

H. Allen. U.S.P. 2,194,256, 19.3.40. Appl. 7.5.37. Multiple seal blow-out preventer.

H. Allen. U.S.P. 2,194,257, 19.3.40. Appl. 2.7.37. Ram with tapered wear plates.

H. Allen. U.S.P. 2,194,258, 19.3.40. Appl. 27.12.37. Ram with laminated plates for blow-out preventers.

H. Allen. U.S.P. 2,194,259, 19.3.40. Appl. 27.12.37. High-pressure multiple plate packing for rams, valves, and blow-out preventers.

H. Allen. U.S.P. 2,194,260, 19.3.40. Appl. 7.6.38. Single-screw blow-out preventer.

H. Allen. U.S.P. 2,194,261, 19.3.40. Appl. 7.5.37. Gate valve, seat, and packing.

H. Allen and M. T. Works. U.S.P. 2,194,262 and 2,194,263, 19.3.40. Appl. 2.7.37. Split housing manifold valve.

J. S. Abercrombie and H. Allen. U.S.P. 2,194,264, 19.3.40. Appl. 27.12.37. Manifold valve.

J. S. Abercrombie. U.S.P. 2,194,265, 19.3.40. Appl. 10.6.38. Braden head and tubing hanger.

H. Allen. U.S.P. 2,194,266, 19.3.40. Appl. 2.7.37. Non-corrosive insert seat for gate valves.

F. M. Mason. U.S.P. 2,194,561, 26.3.40. Appl. 6.12.37. Submersible structure adapted to work in wells.

W. E. Schoeneck. U.S.P. 2,194,616, 26.3.40. Appl. 17.11.37. Means for operating oil wells consisting of special connections of piping.

C. J. Coberly. U.S.P. 2,194,740, 26.3.40. Appl. 22.4.37. Deep well pumping device consisting of a pump and tubings to transmit actuating fluid to, and pumped fluid from pump.

A. K. Wise. U.S.P. 2,196,134, 2.4.40. Appl. 31.1.39. Paraffin cutting and scraping tool consisting of a body and radially disposed fins and a scraper which assumes a horizontal position on the upstroke and a vertical one on the downstroke.

A. H. N.

Transport and Storage.

800.* Expansion Roof Effects Economy in Storage of Gasoline. C. L. Marner. *Oil Gas J.*, 22.2.40, **38** (41), 22.—Tests have been carried out during a thirty-day trial in a special gasometer unit connected to several gasoline tanks in order to obtain data on storage losses during breathing. Hourly records were obtained of atmospheric liquid and vapour temperatures, gasoline and vapour inventory in cubic feet, and the amount of expansion and contraction of vapours above the liquid level of gasoline in the tanks. The principal factors governing the rate of evaporation of the liquid are: Surface temperature, which causes increase or decrease of the pressure of the air–vapour mixture above the liquid fuel—hence the rate at which transition from liquid to vapour takes place; area of evaporation surface and renewal of air over the evaporating surface. It was found that the surface temperature of the gasoline in the tanks was approximately the same as the outside shade temperature, but that there is a time lag when the atmospheric temperature changes. Data are tabulated showing the gasoline content of air vapour mixtures at various surface temperatures, and pressures based on gasoline of 9 lb. Reid V.P. at 100° F., and a diagram reproduced showing the effect of surface temperature of liquid on the expansion of the vapour. C. L. G.

Crude Petroleum.

801. Survey of Crude Oils of the Producing Fields of Arkansas. O. C. Blade and G. C. Branner. U.S. Bureau of Mines: *Report of Investigations No.* 3486, Jan. 1940.—The oil-fields of Arkansas are situated in the southern part of the State and have proved an important factor in development of the northern coastal plain region of the Mid-Continent area. Up to the end of 1938 the region had produced a total of 480,167,560 brl. of crude oil, peak annual production being attained in 1925. Producing fields can be divided into two groups—those developed prior to 1936 wherein the oil is derived almost entirely from Upper Cretaceous formations, and those developed subsequently, largely owing to successful results of geophysical exploration. The later discoveries have been made by deeper drilling, and production is from the Lower Cretaceous and older rocks. The characteristics of the several crude oils examined to a large extent reflect the different geological conditions of oil occurrence.

This report describes the principal oil-fields of the State with reference to forty-five samples of typical crude oils obtained therein. The most prominent property is a high sulphur content; out of the forty-five samples analyzed, thirty-five have 0·7% sulphur or more, the average for all being 1·51%. Other chemical and physical properties change as the sulphur content varies. In classification the largest number of samples is in the intermediate base group, the second largest being naphthene intermediate oils; paraffin and naphthene base types *per se* are, however, also produced.

H. B. M.

Gas.

802.* Hydrogen Sulphide Detector. F. B. Behrens. *Oil Gas J.*, 28.3.40, **38** (46), 86.—A description is given of a hydrogen sulphide detector and alarm based on the operation of a photo-electric cell, a strip of moist lead acetate paper being placed between the light source and the cell. Samples of gas are taken from fifteen different stations at a rate of 20 cu. ft. per min. and passed through the indicator box, the formation of appreciable quantities of lead sulphide shutting off light from the cell and operating the alarm. A micro-ammeter enables an accurate determination of the H_2S content well below the danger point. The instrument has been in operation for well over a year without requiring attention, except for renewals of paper tape and chemical.

C. L. G.

Cracking.

803. Catalytic Cracking of Hydrocarbons. G. Egloff, J. C. Morrell, C. L. Thomas, and H. S. Bloch. *J. Amer. Chem. Soc.*, 1939, **61**, 3571–3580.—The effect at atmospheric temperature of an activated silicon–alumina mass on the reactions of some aliphatic

hydrocarbons was studied under conditions which allowed comparisons between (1) the catalyzed and the uncatalyzed reactions, (2) the cracking of paraffins and olefins of the same chain length, and (3) homologues in both the paraffin and the olefin series. *n*-Butenes were passed over the catalyst at temperatures between 385° and 600° C., and considerable polymerization to materials of high b.pt. and decomposition to lighter gases accompanied isomerization to *i*-butene. At flow rates of 200–230 volumes of gas per volume of catalyst per hour, the isomerization did not change with temperature between 450° and 600° C.; the production of *i*-butene was 24·1% ± 1·5% of the C_4 fraction of the product. *n*-Pentenes yielded 50% of *i*-pentenes when passed over the catalyst at 400° C., and behaved generally in a manner similar to their lower homologues, the *n*-butenes. The effect of the catalyst on *n*-octenes was, first, an isomerization to *i*-octenes, these being principally methylheptenes dimethylhexenes and trimethylpentenes (probably by the migration both of alkyl groups and of the double bond), followed by cracking to gaseous products, consisting, in the main, of *n*- and *i*-butenes and some propene and pentenes. Between 375° and 450° C. conversion amounted to over 80%. The effect of the catalyst on cetene at temperatures between 300° and 450° C. appeared to be: (1) isomerization to more volatile branched-chain hexadecenes, either with or without migration of the double bond; (2) scission of the chain to an almost equal extent at each bond, except those near the extremities of the chain; (3) isomerization of any normally liquid olefinic products to *i*-olefines; and (4) with longer times of contact or at higher temperatures, secondary decomposition of the longer chained primary products. The catalytic cracking of *n*-octane resulted in a lower yield of methane, ethane, and ethylene, and also a higher yield of hydrocarbons with five to seven carbon atoms and of hydrogen, than obtained by pyrolytic cracking; also, it was seven to eight times more rapid. The temperature necessary was higher than that required for the catalytic cracking of the *n*-octenes. The products of the catalytic cracking of cetane, mainly C_3–C_5 hydrocarbons, were quite different from those of thermal cracking. Those products in the gasoline boiling range were a mixture of branched- and straight-chained hydrocarbons, whereas with cetene they were chiefly branched-chain. Although cetane and cetene react in the same way to pyrolytic cracking, cetane does not undergo catalytic cracking so easily as cetene.

R. D. S.

804.* Cracking Coil Control. C. Barnes. *Petroleum*, Feb. 1940, 1, 121.—In thermal cracking the degree of conversion taking place is a function of time, temperature, and character of charging stock. Conventional regulation of a cracking coil from temperature, pressure, and rate of change, while effectively controlling the process within definite limits, does not, in effect, control the actual degree of conversion taking place, which tends to fluctuate with different operations. Unless rate of conversion is constant, there will be a lack of uniformity in the product. To control a cracking unit to maintain a selected degree of conversion involves determination of the time the flowing fluid is in the conversion section of the coil; this has been done as a result of research by R. L. Rude on density of flowing liquids, in collaboration with the British American Oil Co., Ltd., Toronto, Canada, and the Bailey Meter Co., Cleveland, Ohio, and has resulted in the commercial production of an improved control system for cracking coils. The system is based on supplementing the usual control elements by developing a differential head across one or more orifices made at particular points on the path of the fluid. Such "flow responsive" apparatus provides data which can be interpreted as fluid density. The time of detention of the fluid in the conversion part of a coil is given by Vd_m/W, where V is volume of the coil, d_m average density of the fluid taken at inlet and outlet of the conversion section, and W is the weight rate of flow of fluid through a given orifice. The relationship between weight rate W, orifice coefficient C, differential head h developed across the orifice, and the density of the fluid d at the orifice, is given by $W = C\sqrt{hd}$. Particulars, diagrams, and illustrations of the necessary instruments, their construction and layout, are given. H. B. M.

805. Cracking Patents. M. T. Carpenter. U.S.P. 2,189,196, 6.2.40. Appl. 23.11.36. Production of furnace oil from cracking-still distillates, by subjecting the distillates to polymerization at a temperature of 400–600° F. by the action of a catalyst consisting essentially of a calcined mixture of phosphoric acid and kieselguhr. The distillate is then redistilled to produce a fraction suitable for domestic furnace oil and characterized by freedom from formation of gums and non-volatile residues.

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H. Tropsch. U.S.P. 2,194,335, 19.3.40. Appl. 21.6.35. Reforming straight-chain paraffins boiling within the gasoline range by subjecting them in vapour phase and under sub-atmospheric pressure to the action of activated magnesite at a temperature of 1200–1500° F. for a period not longer than four one-hundredths of a second.

N.V. Nieuwe Octrooi Maatschappij. E.P. 518,024, 15.2.40. Appl. 12.8.38. Process for cracking heavy hydrocarbons by introducing them in the vapour phase at a temperature exceeding 480° C., together with a heat-carrier gas into a cracking zone. The gasoline is separated by condensation from the mixture obtained, the remaining gaseous constituents with a boiling point below the range of gasoline compressed and contacted with an absorption liquid. Subsequently a rich vaporous fraction is separated off from the compressed gaseous constituents by absorption, followed by vaporization, and polymerized. H. B. M.

Hydrogenation.

806. Nickel as a Catalyst for the Hydrogenation of Aromatic Halogen Compounds. C. F. Winans. *J. Amer. chem. Soc.*, 1939, **61**, 3564–3565.—The author has been enabled to hydrogenate aromatic halogen compounds containing a readily reducible group by the use of Raney nickel at temperatures below 150°C., and has found that these halogen compounds behave exactly like their unhalogenated analogues in regard to time, temperature, and effectiveness of hydrogenation. R. D. S.

Polymerization.

807. Preparation and Structure of High Molecular Weight Polybutenes. R. M. Thomas, W. J. Sparks, Per K. Frolich, M. Otto, and M. Mueller-Cunradi. *J. Amer. chem. Soc.*, 1940, **62**, 276–280.—The polymerization of *iso*butene is rapid and exothermic and temperature control is important. The general effect of lowering the reaction temperature is to increase the rate of reaction and to produce a polymer of higher molecular weight than obtained by polymerization at elevated temperatures. The best catalysts are titanium tetrachloride, boron fluoride, and aluminium chloride. The lower olefins such as ethylene and propylene are apparently inert to the reaction, but certain compounds, for example, the normal butenes, act as poisons, and a product of lower molecular weight results. This is also the case with the higher olefins and, remarkably enough, the presence of small quantities of di*iso*butene or tri*iso*butene greatly decreases the yield and molecular weight of the poly*iso*butene; this seems to indicate that neither the dimer nor the trimer represent stages in the formation of high polymers. The dimers and trimers themselves do not give high polymers at low temperatures, but at room temperature polymerize slowly to oily products. Other poisons are sulphur compounds and hydrogen halides—the latter cause production of low molecular weight poly*iso*butenes, perhaps by bringing about intermediate formation of di*iso*butene. The hydro-halogen acids exert a beneficial effect upon polymerization of olefins at high temperatures, using boron fluoride as the catalyst. Temperature control being important, diluents are employed to moderate the violence of the reaction and to ensure uniformity of production. The molecular weight of the polymer increases exponentially with concentration of the diluent until 80% diluent is reached, when the molecular weight drops suddenly and precipitously. Catalyst efficiency is highest at greatest dilution, since there is then minimum occlusion of the unreacted catalyst in the diluent. In one of the experiments, at least 0·03% of catalyst was required for the reaction to commence. Generally speaking, the yields of these reactions are 90% or better, but the yield has no influence upon the average molecular weight of the poly*iso*butenes. A brief discussion on the structure of these materials is given in this paper, and the authors conclude that the polymers are linear, probably in a "head to tail" formation, although "head to head" and random structures are possible, as well as mixtures of all three types. It is assumed that all of these structures include one residual terminal double bond. R. D. S.

808. Patents on Polymerization. Rohm and Haas A.-G. E.P. 517,195, 23.1.40. Appl. 22.7.38. Method of polymerizing symmetrical dichloroethylene, employing as catalyst one or more peroxides, *e.g.*, benzoyl peroxide, hydrogen peroxide, or tetrahydro-naphthalene peroxide.

Rohm and Haas A.-G. E.P. 517,213, 23.1.40. Appl. 30.8.38. Production of technically valuable chlorinated hydrocarbons, including the step of polymerizing trichlorethylene, using one or more inorganic or organic peroxides as catalysts. High molecular products are not obtained to any appreciable extent, the products being essentially dimeric and trimeric fluid products and little higher polymeric products.

I.G. Farbenindustrie A.-G. E.P. 517,799, 8.2.40. Appl. 6.12.38. Catalytic polymerization of low molecular olefines or mixtures containing same to liquid hydrocarbons in the presence of phosphoric acids or phosphoric acid anhydride. An admixture of free metals which are less electro-positive than hydrogen is used with the acids in finely-divided form.

I.G. Farbenindustrie A.-G. E.P. 518,054, 15.2.40. Appl. 17.10.38. Process for the polymerization of olefines having tertiary carbon atoms, with sulphuric or phosphoric acids of medium or high concentration. The olefines, if desired in admixture with other unsaturated or saturated hydrocarbons, are allowed to trickle with the acid through high reaction chambers charged with filler bodies or other materials having a dispersing action. Thereafter the layers of the reaction product formed by sedimentation are separated from each other.

Sinclair Refining Co. E.P. 518,163, 20.2.40. Appl. 17.5.38. Improved process for the production of polymerized olefins from hydrocarbon gas mixtures containing olefins. A gaseous mixture containing a substantial amount of normally gaseous higher olefins is passed at a temperature not substantially in excess of 550° F. in contact with a polymerization catalyst such as solid phosphoric acid deposited on silica.

I.G. Farbenindustrie A.-G. E.P. 518,558, 29.2.40. Appl. 5.9.38. Process for the catalytic depolymerization of polymers of low boiling mono-olefines by working in the presence of appreciable amounts of steam.

R. F. Ruthruff. E.P. 518,749, 6.3.40. Appl. 1.9.38. Polymerization of olefinic hydrocarbons by contacting at an elevated temperature with a solid catalyst composed of a mixture of pyrophosphate and an inactive substance.

J. W. C. Crawford. E.P. 518,970, 13.3.40. Appl. 5.9.38. Manufacture of polymerization products from alpha-chloroacrylic acid and its esters. H. B. M.

Synthetic Products.

809. Patents on Synthetic Products. Studien- und Verwertungsgesellschaft mit Beschrankter Haftung. E.P. 517,002, 17.1.40. Appl. 27.7.38. Production of paraffin wax from gases containing carbon monoxide and hydrogen, using catalysts of cobalt or a mixed catalyst containing cobalt at a temperature below 200° C. and under a pressure of at least two atmospheres.

E. I. Du Pont de Nemours & Co. E.P. 517,143, 22.1.40. Appl. 19.7.38. Production of mono- and dimethyl formamides by reacting methanol with carbon monoxide and ammonia at a temperature between 150 and 300° C. and at a pressure of 300 to 1000 atmospheres.

Armour & Co. E.P. 517,247, 24.1.40. Appl. 31.8.38. Preparation of di-esters of unsaturated glycols by reacting a fatty acid chloride having 12–18 carbon atoms with an inert solvent.

Carbide and Carbon Chemicals Corporation. E.P. 517,332, 26.1.40. Appl. 23.7.38. Process for activating silver surface catalysts, particularly for use in effecting the direct chemical combination of olefines with molecular oxygen to form olefine oxides. The silver is treated with ozone and water vapour to form silver peroxide and the ozonized silver thereafter so treated as to alter chemically the silver oxide and form an active surface catalyst.

Carbide and Carbon Chemicals Corporation. E.P. 517,333, 26.1.40. Appl. 23.7.38. Improvements in the process of making olefine oxides by direct catalytic oxidation of olefines by means of molecular oxygen.

D. J. Branscombe and Imperial Chemical Industries. E.P. 517,382, 29.1.40. Appl. 25.7.39. Manufacture of new iodinated esters by causing a saturated or unsaturated aliphatic alcohol containing at least three carbon atoms to interact with a mono- or polyiodo-aromatic homocyclic or heterocyclic carboxylic acid, or with the acid halide of such an acid, or alternatively by causing a halogen ester of the said alcohol to interact with a neutral salt of the said acid.

E. I. Du Pont de Nemours. E.P. 517,582, 2.2.40. Appl. 29.7.38. Preparation of new dihydropolycyclic aromatic hydrocarbon-sulphur reaction products and a lubricating compound containing these products as lubricant assistants.

I.G. Farbenindustrie A.-G. E.P. 517,673, 6.2.40. Appl. 3.8.38. Manufacture of 1-amino-2-chloro(or bromo)-4(or 6)-nitrobenzene-6(or 4)-sulphonic acid, wherein a 4(or 6)-nitrobenzene-6(or 4)-sulphonic acid, containing a halogen atom in 1-position and in 2-position a chlorine or bromine atom, is treated with ammonia.

I.G. Farbenindustrie A.-G. (E.P. 517,674, 6.2.40. Appl. 3.8.38. Manufacture of 2-chloro(or bromo)-4(or 6)-nitro-1-aminobenzene-6(or 4)-sulphonic acid, wherein 4(or 6)-nitro-1-aminobenzene-6(or 4)-sulphonic acid or a salt thereof is treated in water or an aqueous salt solution or an inert organic solvent at ordinary or reduced temperature with elementary chlorine or bromine.

I.G. Farbenindustrie A.-G. E.P. 517,685, 6.2.40. Appl. 3.8.38. Manufacture of α-halogenvinyl methyl ketones by causing hypochlorous acid or hypobromous acid to react on vinyl methyl ketone and splitting off water from the condensation products thus obtained by steam distillation.

I.G. Farbenindustrie A.-G. E.P. 517,692, 6.2.40. Appl. 4.8.38. Manufacture of β-indole acetic acids by reacting an indole which is unsubstituted in the β-position to the nitrogen atom with formaldehyde and hydrocyanic acid or a salt thereof and then saponifying the β-indole acetic acid nitrile to the corresponding carboxylic acid.

The Distillers Co., Ltd. E.P. 517,740, 7.2.40. Appl. 3.8.38. Manufacture of formaldehyde from carbon monoxide and hydrogen or a gas mixture containing them, by the joint action of heat and a catalyst. The catalyst is prepared from nickel as pure as possible with which has been incorporated up to 5% of one or more activators, *e.g.*, zinc, lead, manganese, magnesium, iron, silicon.

N.V. de Bataafsche Petroleum Maatschappij. E.P. 517,758, 7.2.40. Appl. 4.8.38. In the manufacture of *iso*butane from normal butane the normal butane or normal butane-containing mixtures not containing substantial proportions of olefines are passed continuously in the gaseous phase at temperatures below 200° C., over a solid catalyst. The catalyst consists of aluminium chloride mixed with or brought on to a carrier substance with such a short contact time that substantially no decomposition and formation of higher boiling products takes place.

James Anthony and Co. E.P. 517,793, 8.2.40. Appl. 6.8.38. Improvement in the manufacture of organic acids by fermentation of carbohydrates by a mycelium-producing mould. The nutrient solution for the fermentation is treated before it is inoculated with the ferment with an agent which destroys vitamins or other growth stimulants.

G. L. Stahly and W. W. Carlson. E.P. 517,820, 9.2.40. Appl. 4.8.38. Production of a benzyl ether of dextran by reacting dextran with a mixture of benzyl halide, an

alkali hydroxide, and water, and continuing the reaction until a dextran ether derivative soluble in acetone is obtained.

Boots Pure Drug Co., Ltd. E.P. 518,149, 19.2.40. Appl. 21.9.38. Preparation of mono-chlorinated derivatives of ethylene in which the other three hydrogen atoms of the ethylene are substituted by the same or different aromatic groups. The corresponding triaryl ethylene dissolved in a suitable solvent is treated with chlorine.

N.V. de Bataafsche Petroleum Maatschappij. E.P. 518,325, 23.2.40. Appl. 7.9.38. Production of unsaturated halogen-containing derivatives of propene, preferably allyl chloride, by dehydrohalogenation of a polyhalogen propane capable of splitting off hydrogen halide (*e.g.*, propylene chloride). The vapours of the polyhalogen propane are subjected to a temperature above 450° C. for a length of time sufficient to dehydrohalogenate about 40% of the polyhalogen propane.

G. W. Johnson. E.P. 518,372, 26.2.40. Appl. 22.8.38. Improvements in the synthesis of hydrocarbons with more than one carbon atom in the molecule and contingently minor amounts of liquid or solid oxygen-containing derivatives thereof by conversion of carbon monoxide with hydrogen. Gases already subjected to the reaction are returned to the reaction space, the volume per unit of time of the gases returned being at least twenty times that of the fresh gas introduced.

Universal Oil Products Co. E.P. 518,392, 26.2.40. Appl. 15.9.38. Hydrogenation of octanes by subjecting their vapours in admixture with a molal excess of hydrogen of less than 60% to contact with a catalyst comprising reduced nickel at a temperature between 170 and 215° C. under a pressure of from atmospheric to 14·1 kg. per cm. The time of contact corresponds to liquid space velocities of approximately four per hour.

W. G. Groves. E.P. 518,450, 27.2.40. Appl. 29.9.38. Manufacture of alkyl substituted phenols of the benzene series by subjecting the sodium salt of the aromatic sulphonic acid corresponding with the desired phenol to fusion with sodium hydroxide in the presence of the sodium salt of another aromatic sulphonic acid or the sodium salt of a phenol.

G. W. Johnson. E.P. 518,605, 1.3.40. Appl. 15.7.38. Production of liquid hydrocarbons by the catalytic conversion of carbon monoxide with hydrogen. Cyclic hydrocarbons are added which are vaporized to a substantial extent under the reaction conditions.

Studien- und Verwertungesellschaft. E.P. 518,614, 4.3.40. Appl. 30.7.38. Hydrocarbons which are solid, liquid, or readily liquefiable can be produced from gases containing carbon monoxide and hydrogen in equal amounts or more carbon monoxide than hydrogen, under pressures between two and ten atmospheres and at temperatures below 320° C. in the presence of iron catalysts, if the catalysts are pretreated with gases containing carbon monoxide under normal pressure or some pressure which is lower than that used in the subsequent production of hydrocarbons.

I.G. Farbenindustrie A.-G. E.P. 518,656, 4.3.40. Appl. 1.9.38. Manufacture of *N*-substituted aminosulphonic acids and aminocarboxylic acids by causing a primary aminosulphonic acid or aminocarboxylic acid salt to react with an aliphatic or *cyclo*-aliphatic aldehyde or ketone and, with or without isolating the reaction product, reducing same catalytically with hydrogen.

Carbide and Carbon Chemicals Corporation. E.P. 518,685, 5.3.40. Appl. 2.9.38. Production of an alkenylbenzene at a high rate of reaction and with minimum formation of by-products and resinous materials by the dehydrohalogenation of a halogenated alkylbenzene. An α-halogenated alkylbenzene is passed into a molten catalyst consisting of an amine having at least two organic radicals attached to the nitrogen atom, each containing more than four carbon atoms. The alkenylbenzene is removed from the catalyst in the vapour phase as it is formed.

W. W. Groves. E.P. 518,697, 5.3.40. Appl. 3.9.38. Manufacture of dichlorobutenes by causing gaseous chlorine to act on gaseous butadiene in the presence of a diluent which is inert to chlorine and butadiene.

Standard Oil Development Company. E.P. 518,775, 7.4.40. Appl. 1.9.38. Preparation of alkyl phenol sulphides by heating alkylphenol together with sulphur and an inorganic compound of an alkali metal, in the presence of a non-aqueous inert solvent. Heating is continued until evolution of hydrogen sulphide ceases, and thereafter the free alkylphenolsulphide is obtained by treatment with acid.

Carbide and Chemicals Corporation. E.P. 518,823, 8.3.40. Appl. 7.8.37. Manufacture of olefine oxides by the direct chemical combination of olefines with molecular oxygen in the presence of active surface catalysts. Complete oxidation of the olefines is repressed by incorporating inhibitors with the reactants.

W. J. Tennant. E.P. 518,915, 12.3.40. Appl. 10.6.38. Preparation of Δ_1-alkenyl malonic or cyanoacetic esters by the reaction of an alkylidene (other than the ethylidene) malonic or cyanoacetic ester with an alkylating agent consisting of an alkyl or aralkyl salt in the presence of an isomerization agent.

E. I. Du Pont de Nemours & Co. E.P. 518,985, 13.3.40. Appl. 12.9.38. Manufacture of benzidine by the reaction of nitrobenzene with hydrogen in the presence of a nickel catalyst and an aqueous alkaline solution. Thereafter the aniline is separated from the other reaction products and the latter converted into benzidine.

Les Usines de Melle. E.P. 518,998, 13.3.40. Appl. 4.10.38. Production of aliphatic ethers from aliphatic alcohols by subjecting the latter to an acid dehydrating process of such a nature that a relatively large proportion of the olefine is produced. The olefine is recovered, converted into alcohol, and returned to the reaction vessel.

F. J. Cahn. E.P. 519,072, 15.3.40. Appl. 13.9.38. Preparation of alkylolamine salts of lower molecular weight sulphocarboxylic esters of higher molecular weight alcohols.

B. R. Harris. E.P. 519,230, 20.3.40. Appl. 4.10.38. Conversion of a salt of a lower molecular weight sulphocarboxylic acid ester of a higher molecular weight alcohol into a different salt of said ester. An aqueous solution of the original salt is passed into contact with a base-exchange material containing replaceable cations of the second salt whereby an exchange of cations takes place and the second mentioned salt of the sulphocarboxylic acid ester is formed.

L. Auer. U.S.P. 2,189,772, 13.2.40. Appl. 23.10.26. Improved heat-bodied oil products are obtained by mixing about 5% of dry sodium oxalate with a fatty oil and heating the mixture until the salt is dispersed (300–350° C.).

A. L. Davis. U.S.P. 2,191,455, 27.2.40. Appl. 29.9.38. Process for the extraction of a fat or oil from an oleaginous material of non-mineral origin which contains colouring matter soluble in the said fat or oil. The material is subjected to the action of a liquid solvent mixture consisting of a liquid saturated hydrocarbon having 3 to 4 carbon atoms and a small proportion of an ether selected from the group consisting of dimethyl ether, methyl ethyl ether, and diethyl ether. Thereafter the extract is separated from the residue and finally the solvent from the residue.

O. M. Reiff. U.S.P. 2,191,498, 27.2.40. Appl. 27.11.35. Manufacture of mineral oil composed of liquid oils and waxy hydrocarbons in which is incorporated a small proportion of wax-substituted phenol prepared from chlor-wax, unsubstituted phenol, and anhydrous aluminium chloride. The mixture is heated to approximately 350° F. and thereafter water is added to remove the aluminium chloride.

S. Musher. U.S.P. 2,192,866, 5.3.40. Appl. 20.8.38. Production of a novel mineral oil composition containing a small amount of the mineral oil soluble constituents derived from a dehydrated, low moisture containing salted, macerated olive paste. The oil is substantially free of the fibres of the olive paste.

L. A. Hamilton. U.S.P. 2,193,331, 12.3.40. Appl. 2.2.39. Preparation of a mineral oil composition in which is incorporated a small proportion of the product obtained by reacting sulphur chloride with a solvent tar derived from the solvent extraction of petroleum. The reaction product is first treated to remove corrosive sulphur, and is present in sufficient amount to inhibit the deleterious effect of oxidation on the oil.

A. A. Levine. U.S.P. 2,193,823, 19.3.40. Appl. 9.4.37. Preparation of pentachlorostyrene by passing chlorine gas into liquid ethylpentachlorobenzene maintained at a temperature between 60 and 200° C. in the presence of light but in the absence of a halogenated catalyst. H. B. M.

Refining and Refinery Plant.

810.* Large Houdry Catalytic Gasoline-Treating Unit. H. S. Norman. *Oil Gas J.*, 28.3.40, **38** (46), 106.—Reference is made to various types of Houdry catalytic plants in operation, and a description is given of a Houdry catalytic gasoline-treating plant at Marcus Hook, Pa., of 18,000 brl. daily capacity. Cracked and reformed gasoline from the catalytic cracking plants is heated by heat exchange to 250° F. at 200 lb. pressure, and in a furnace to 660° F., and passed to one of the two catalytic treating cases at 645° F. After heat exchange it passes to the fractionating tower at 540° F., where 2% of polymer bottoms are removed. The catalyst cases are operated in three-hour cycles, regeneration of one tower being effected by blowing air heated to 700° F. through it after purging with steam to remove oil vapour. The resulting oxidation of mercaptans, sulphur, and carbon deposits raises the temperature to 1000° F., the catalyst being finally cooled to the operating temperature by a molten salt-circulating system. Treating of the gasoline results in a reduction of the gum (copper dish) from 35 to 6 mgm., and gives a good colour, doctor sweet and satisfactory copper strip test product without any loss in octane number. Gasoline with copper dish gum tests of 200 mgm. have been reduced to 5–7 mgm. by this process. C. L. G.

811.* Caustic Washing of Gasoline and Caustic Regeneration. L. M. Henderson, G. W. Ayres, and L. M. Ridgway. *Oil Gas J.*, 28.3.40, **38** (46), 114.—In an investigation into the reason for the incompleteness of the regeneration of caustic soda used for the preliminary washing of cracked and straight-run gasolines from various Texas crudes, it was found that a number of organic acids were present in the gasolines. These are not appreciably hydrolyzed in the boiling aqueous solution, and consequently cannot be removed by steam regeneration, although they do not interfere with the reaction of the lower boiling aliphatic mercaptans. The acids from the soda washing of a cracked Texas gasoline largely consisted of *o*-thiocreosol, with smaller amounts of *p*-thiocreosol, thiophenol, *o*-cresol, phenol, and naphthenic acids. Water soluble acids, *e.g.*, formic, acetic, *iso*butyric, *iso*valeric, etc., were also identified in the caustic-soda extract. In some cases the water-soluble organic acids amounted to 70% of the total acidity, so that a preliminary water wash of the gasoline is indicated. C. L. G.

812.* Refining Characteristics of Mississippi Crude Oils. G. Egloff and G. B. Zimmerman. *Oil Gas J.*, 28.3.40, **38** (46), 145.—A laboratory distillation has been carried out on two samples of crude oils from the Tinsley field, Yazoo County, Mississippi. The crude oils had the following average properties: S.G. 0·848; Sulphur 0·77%; Cold test 15° F.; Visc. S.U./100° F. 69. Estimated yields on refining were: 250° E.P .gasoline (61 O.N.) 12·0%, or 400° E.P. gasoline (41 O.N.) 29·2%; kerosine 9·5%; light gas oil 21·4%; heavy gas oil 19·8%; and residue 19·9%. The low octane rating of the gasoline indicates the necessity for cracking and reforming cracking of the topped crude. After removing the 400° E.P. gasoline, reforming the naphtha and polymerization of the cracked gases gives 66·2% of 68/70 O.N. gasoline. When making 9·5% kerosine, cracking the remaining crude, reforming and polymerizing, a yield of 57·5% of 67/69 O.N. gasoline is obtained. Omitting the naphtha reforming a yield of 40·5% of cracked and polymer gasoline of 68/70 O.N. is obtained, while when kerosine is manufactured the yield of cracked and polymer gasoline is reduced to 31·8%. The

straight-run gasoline is sweet, but the cracked material requires sweetening and inhibiting. A yield of over 25% of asphalt may be obtained by blowing. Lubricating-oil production would involve dewaxing and probably solvent extraction in addition to decolorizing treatment. C. L. G.

813.* Factors Affecting the Refiner's Choice of Crudes. G. A. Beiswenger. *Petrol. Tech.*, Feb. 1940, A.I.M.M.E. Tech. Pub. No. 1155, 1–11.—With relatively few exceptions, available processing methods and addition agents make it theoretically possible to produce any type of refined product from any crude source, although it may not be economically sound to do so. There is a practical limit to the production of high-quality products from inferior feed stocks. By physical and chemical tests and a small-scale distillation, it is possible to make a selection from crudes according to available processing equipment and the products required.

The desirable features and the means whereby they may be obtained are discussed for gasolines, kerosines, tractor fuels, gas oils, lubricating oils, and asphalts, and the characteristics of crudes suitable for giving various products are indicated and also set out in tabular form. G. D. H.

814.* Engineer and Chemist in the Refining of Petroleum. A. J. Zanetta. *Bol. Inform. Petroleras*, Dec. 1939, XVI (184), 5–18.—This is a well-illustrated paper in which Dr. Zanetta deals with the various processes applied to the crude petroleum in order to obtain many different products of importance. He points out the essential part played by the chemist in collaboration with the engineer in perfecting these refining processes. H. I. L.

815.* Dehydration and Desalting of Petroleum in Mendoza. Fermo Monti. *Bol. Inform. Petroleras*, Dec. 1939, XVI (184), 27–29.—The presence of large quantities of sodium chloride in the crude oil has the effect of choking the tubes of the heat interchangers, of depositing carbon in the still tubes, of corrosion due to the acid reactions taking place, and finally of depositing ash in the burners of oil-burning plant and thus increasing the consumption. Analyses of the oils at Cacheuta and Tupungato are given (Tables 1 and 2), and particulars are given of the results of dehydration and desalting by the electrical method. Tables 3 and 4 give particulars of the trials carried out, which resulted in an efficiency of 85·54%. The best results were obtained either without the addition of extra water or with the addition of 10% of soft water. H. I. L.

816.* Desalting of Petroleum at Plaza Huincul. R. Carrozzi, L. Hudson, and V. Garcia Cano. *Bol. Inform. Petroleras*, Dec. 1939, XVI (184), 30–34.—This article bears on the same subject as the foregoing abstract. A table is given showing the percentage of salt contained in the different oils extracted in the Argentine. Results of trials by centrifuging and by heating under pressure for the separation of salts in oils obtained at Plaza Huincul are shown in Tables 2 and 3, while treatment by electricity is detailed in Table 4. At the La Plata refinery sulforricinate of ammonia is used for desalting, in the proportion of 1 to 8000 parts by volume of petroleum (see Table 4). Neither the operation of centrifuging nor that of heating under pressure is as efficacious or as efficient as the electric treatment. H. I. L.

817. Refining Patents. R. B. Day. U.S.P. 2,189,058, 6.2.40. Appl. 14.4.37. Refining hydrocarbon oils by contacting the oil in the absence of hydrochloric acid with a dry, preformed solid reaction product of a zinc silicate and hydrochloric acid, the said product being substantially devoid of free hydrochloric acid.

F. W. Breth. U.S.P. 2,189,128, 6.2.40. Appl. 17.7.36. Refining of mineral oil by treating with oleum in the presence of a member of the group consisting of urea and salts of urea under sulphonating conditions, and recovering from the treated oil the mahogany sulphonic bodies formed during sulphonation.

J. V. Starr and G. A. Beiswenger. U.S.P. 2,189,844, 13.2.40. Appl. 18.10.33. Treatment of mineral oil containing asphalt by extracting with a mixture comprising a selective solvent of the phenol type and a halogenated hydrocarbon having a specific gravity higher than 1.

T. C. Whitner, Jr. U.S.P. 2,189,850, 13.2.40. Appl. 6.3.37. Removal of mercaptans from a sour petroleum distillate by converting the mercaptans to copper mercaptides which remain dissolved in the distillate. Subsequently the copper mercaptides are removed from the distillate with an alkyl amine.

W. J. Edmonds. U.S.P. 2,189,885, 13.2.40. Appl. 18.9.31. Separation of wax from oil by diluting the oil with a liquefied normally gaseous hydrocarbon solvent and cooling the mixture to successively lower wax separation temperatures in a plurality of separate chambers. The precipitated wax is separated from the oil solvent mixture in the last chamber and the solvent removed from the dewaxed oil.

C. Ellis. U.S.P. 2,190,471, 13.2.40. Appl. 26.8.38. Sulphuric acid-treated cracked petroleum distillate is treated with a hydrocarbon-soluble heavy metal salt of a phenolic body and insoluble metallic compounds allowed to form. Thereafter the insoluble compounds are separated and the ability of the distillate to develop acidic compounds on distillation thus suppressed.

J. B. Staten. U.S.P. 2,191,357, 20.2.40. Appl. 15.12.37. Petroleum emulsions of the water-in-oil type can be broken by treating with cactus juice.

J. B. Rogerson. U.S.P. 2,194,269, 19.3.40. Appl. 21.3.38. Treatment of salt-impregnated crude oil by heating under super-atmospheric pressure adapted to prevent excessive deposition of salt in the heating equipment. Thereafter the pressure is reduced to a degree adapted to effect vaporization of water and low boiling point constituents, and finally the unvaporized constituents are filtered to remove the crystallized salt.

C. M. Loane. U.S.P. 2,194,312, 19.3.40. Appl. 13.6.38. Deterioration of refined mineral oils is prevented by dissolving in the oil less than 0·04% of a product formed by condensing with a Friedel–Crafts catalyst, chlorinated paraffin wax with a compound selected from the group consisting of naphthols and polyhydroxyl benzenes.

D. L. Pennington and W. L. Benedict. U.S.P. 2,194,321, 19.3.40. Appl. 31.12.37. Refining of hydrocarbon distillates by subjecting them to the sweetening action of a copper compound and afterwards treating the distillate with a salt of orthophosphoric acid to remove objectionable reaction products.

C. Wirth. U.S.P. 2,195,833, 2.4.40. Appl. 30.9.37. Method of removing salt water or brine from hydrocarbon oil by heating in a flowing stream to a temperature between 325 and 375° F. at super-atmospheric pressure. A stream of water is separately heated to the same temperature under sufficient pressure to prevent vaporization, and the two streams thereafter commingled. The mixture while still in a heated state is introduced into a settling chamber wherein the conditions are such that the resultant salt water and de-salted oil are caused to stratify.

G. W. Johnston. E.P. 517,618, 5.2.40. Appl. 27.7.38. Removal of phenols from oils and waste aqueous liquors by extracting the oils while heating under pressure with the aid of a waste aqueous liquor containing phenols. Subsequently the extract is separated at atmospheric or increased pressure by cooling into phenols and water containing phenols. The latter is treated with extraction or adsorption agents for the removal of the phenols.

E. A. Ocon. E.P. 518,263, 22.2.40. Appl. 12.7.38. Preheated bituminous oil is injected into a flash zone and a substantial portion thus vaporized. Subsequently hot vapours are passed into the flash zone to increase the amount of vapours and a portion of the resulting residues is subjected to distillation under cracking conditions. The vapour products of distillation are filtered through an absorbent contact mass capable of eliminating deleterious coke-forming substances, and are afterwards used as the hot vapours in the flash zone.

G. W. Johnson. E.P. 518,745, 6.3.40. Appl. 31.8.38. Separation of hydrogen chloride from mixtures containing olefines or diolefines having at least four carbon atoms. The mixture is brought into contact with a liquid substance which is stable to hydrogen chloride and has a boiling point above that of hydrogen chloride and below that of olefines or diolefines in the gaseous mixture. H. B. M.

Safety Precautions.

818. Procedure for Applying for Tests made on all Explosives and Blasting Devices by the Explosives Division of the Bureau of Mines. Anon. U.S. Bureau of Mines: *Schedule IC*, 1939.—This schedule gives full information regarding practical tests of explosives by the appropriate Division of the Bureau. The scope of the tests covers explosives for use in coal-mines to determine their permissibility; for metal mines, tunnels, quarries, and other engineering operations (which presumably includes oil-well drilling) to determine their characteristics; blasting devices for use in coal-mines or relevant to any one of the individual tests listed in the schedule. The information includes instructions for submitting for test explosives and equipment for blasting devices; conditions under which tests are made; methods of testing involving chemical analysis (as laid down in U.S. Bureau of Mines *Bulletins* 51, 96, 219, *Technical Papers* 78, 160, 162, 282, and *Report of Investigations* 3337), also physical tests which are individually described and include physical examination, unit deflective charge, gallery tests, determination of gaseous products of explosion, rate of detonation, pendulum friction test, explosion by influence test, and large impact test. Provisions are stated for the permissibility of explosives and blasting devices and tolerances allowing for reasonable limits of variation in results of analyses and tests are enumerated. H. B. M.

Chemistry and Physics of Petroleum.

819. Hydrogen Bonds Involving the C–H Link. VIII. The Solubilities of Completely Halogenated Methanes in Organic Solvents. M. J. Copley, G. F. Zellhoefer, and C. S. Marvel. *J. Amer. chem. Soc.*, 1939, **61**, 3550–3552.—This paper gives solubility data on CCl_3F and CCl_2F_2 in a wide range of organic solvents at 32·2° C. and at various pressures. The solubilities are almost always lower than would be predicted from Raoult's law, indicating that compound formation between solvent and solute does not occur. This work gives support to an earlier postulation of the authors that C–H ⟵ O and C–H ⟵ N bonds are formed by the hydrogen of the halogenated methane and the oxygen and nitrogen atoms of the solvent molecules. R. D. S.

820. Action of Elementary Fluorine in Organic Compounds. VI. The Vapour-Phase Reaction between Ethane and Fluorine in Progressively Varying Proportions. J. D. Calfee, N. Fukuhara, and L. A. Bigelow. *J. Amer. chem. Soc.*, 1939, **61**, 3552–3554.—An account is given of the vapour-phase fluorination of ethane over a copper gauze catalyst in which the gases reacted in progressively varying proportions. The more important products have been identified, and the approximate proportions in which they have been formed have been determined. In each case a smooth reaction took place. R. D. S.

821. The Action of Aluminium Chloride on Aromatic Hydrocarbons. II. The 1 : 3-Dimethyl-4-Propylbenzenes. D. Nightingale and B. Carton, Jr. *J. Amer. chem. Soc.*, 1940, **62**, 280–283.—Whereas 1 : 3-dimethyl-4-*iso*propylbenzene yields 1 : 3-dimethyl-5-*iso*propylbenzene as the principal trialkylbenzene when warmed with aluminium chloride for three hours at 55° C., the 1 : 3 : 4-normal compound hardly changes and, in fact, requires to be kept at 100° C. for four hours before there is any considerable change to the 1 : 3 : 5-*iso*hydrocarbon. The 1 : 3 : 4-normal hydrocarbon was synthesized from *m*-xylene and *cyclo*propane using aluminium chloride as the catalyst, and it was also prepared by the reduction of 4-propionyl-*m*-xylene. The 1 : 3 : 5-*iso*-compound was synthesized from *m*-xylene and three different alkylating agents, namely, *iso*propyl chloride, normal propyl chloride, and normal propyl formate, again using aluminium chloride as catalyst. These syntheses give support to the contention of Smith and Perry (*J. Amer. chem. Soc.*, 1939, **61**, 1411–1412; *J. Inst. Pet.*, 1939, **25**, Abstr. No. 1362) that, during the alkylation of *m*-xylene in the presence of aluminium chloride, a 1 : 3 : 4-hydrocarbon is the initial product, which is subsequently rearranged to yield a 1 : 3 : 5-hydrocarbon. R. D. S.

822. Remarks on the Structure of Fluorene. E. Bergmann and T. Berlin. *J. Amer. chem. Soc.*, 1940, **62**, 316–317.—When 2-acetoxyfluorene undergoes the Fries rearrangement the product is 1-acetyl-2-hydroxyfluorene and, similarly, 2-acetoxyfluorenone gives 1-acetyl-2-hydroxyfluorenone. The rearrangement of 2-allyloxyfluorenone, however, gives two isomers, the 1- and the 3-allyl-2-hydroxyfluorenone, forming a well-crystallized molecular compound. Thus, as has been previously stated, no fixed "fine structure" exists in fluorene, but the dibenz*ocyclo*pentadiene framework seems to hold. R. D. S.

823. Action of Fluorine upon some Simple Aliphatic Chlorinated Hydrocarbons. W. T. Miller. *J. Amer. chem. Soc.*, 1940, **62**, 341–344.—The reactions of the lower aliphatic chlorinated hydrocarbons with pure fluorine were generally smooth and easily controlled, and they occurred principally in the gas phase and at the liquid surface under essentially "non-ionic" conditions. Some of the differences between the reactions of fluorine and the reactions of the other halogens with these aliphatic compounds may be due to the radical type mechanisms functioning, in which the fluorine molecule is split symmetrically, and the author considers that this type of mechanism is of the greatest importance in this connection. The types of reactions observed were: substitution of hydrogen attached to saturated carbon; substitution of hydrogen attached to double-bonded carbon; addition to ethylenic bonds; dimerization of saturated molecules by removal of two hydrogen atoms; dimerization of ethylene derivatives accompanied by the addition of two fluorine atoms; secondary reactions due to the presence of chlorine fluoride. R. D. S.

824. Chlorination of 1-Hexyne in Reactive Solvents. II. R. O. Norris and G. F. Hennion. *J. Amer. chem. Soc.*, 1940, **62**, 449–450.—The study of the chlorination of 1-hexyne in various oxygen-containing solvents has been continued with special reference to the effect of high proton concentrations on the reaction. 1-Hexyne was chlorinated as an emulsion in concentrated hydrochloric acid, 30% sulphuric acid, and 30% phosphoric acid, and as a solution in methanol saturated with hydrochloric acid. Both *cis*- and *trans*-1 : 2-dichloro-1-hexene were obtained, but oxygen-containing compounds were not isolated. A trichloride having b.pt. 90–93° C. at 10 mm. is now reported as 1 : 1 : 2-trichloro-1-hexene rather than as 1 : 2 : 1-trichlorohexane as previously formulated; indeed the authors were unable to prepare the latter from 1-hexyne. Chlorination of 2-chloro-1-hexene produced *cis*-1 : 2-dichloro-1-hexene and 1 : 1 : 2 : 2-tetrachlorohexane. The authors suggest a mechanism for the reactions occurring in the investigation. R. D. S.

825. Hydrogen Fluoride as a Condensing Agent. IX. Reactions of Di- and Tri*iso*-butylene with Phenol. J. H. Simons and S. Archer. *J. Amer. chem. Soc.*, 1940, **62**, 451.—With large quantities of hydrogen fluoride di- and tri-*iso*butylene both suffer cleavage to give p-*tert.*-butylphenol; however, with smaller quantities of hydrogen fluoride, di*iso*butylene gives an uncleaved product, p-*tert.*-octylphenyl, although tri*iso*butylene did not give any compound that corresponded to the expected dodecylphenol—perhaps even milder conditions are required. R. D. S.

826. Inhibition of Ethylene Polymerization by Nitric Oxide. H. D. Burnham and R. N. Pease. *J. Amer. chem. Soc.*, 1940, **62**, 453.—The polymerization of ethylene is subject to acceleration by substances believed to give rise to radicals, and the authors now find that the reaction is inhibited by nitric oxide, the effect of which falls off as the reaction advances, as in the case of the inhibition of the hydrogenation of ethylene, mentioned in the following communication (Abs. 827). The polymerization of ethylene is therefore evidently of the radical chain type. R. D. S.

827. Inhibition of the Hydrogenation of Ethylene by Nitric Oxide. H. D. Burnham and R. N. Pease. *J. Amer. chem. Soc.*, 1940, **62**, 453.—Since the dissociation of ethane to yield ethylene and hydrogen is inhibited by nitric oxide one might expect the reverse reaction to be similarly affected. The authors find this to be the case. The effect of the inhibition tends to fade out as the reaction proceeds. R. D. S.

828. Photochemical Reactions of Oxalyl Chloride and Phosgene with *cyclo*Hexane. M. S. Kharasch and H. C. Brown. *J. Amer. chem. Soc.*, 1940, **62**, 454.—In the photolysis of both phosgene and oxalyl chloride in *cyclo*hexane in the liquid phase, the authors have isolated the acid chloride of *cyclo*hexane carboxylic acid quantitatively, and they believe the reaction takes place through a free radical or atom mechanism in which the formation of the –COCl free radical plays a leading rôle. R. D. S.

829.* Polycyclic Aromatic Hydrocarbons. Part XXI. G. M. Badger, J. W. Cook, and F. Goulden. *J. chem. Soc.*, Jan. 1940, 16–18.—The syntheses of the 6 : 9 : 10-trimethyl and the 5 : 6 : 9 : 10-tetramethyl derivatives of 1 : 2-benzanthracene is described.

These two compounds, together with 1 : 2 : 9 : 10-tetramethylanthracene, were tested for carcinogenic and growth-inhibitory activity, the results being published elsewhere. E. H. W.

830.* Thermal Polymerization of Styrene and its Inhibition. S. G. Foord. *J. chem. Soc.*, Jan. 1940, 48–56.—The author has investigated the effect of a considerable number of organic compounds on the rate of polymerization of pure styrene. Two main groups were classified, " inhibitors " and " retarders."

A detailed examination of benzoquinone and related substances was made. From the results on these strong inhibitors, support is claimed for a theory of the kinetics of stabilization by inhibitors. E. H. W.

831.* Examination of the Mechanism by Which " Cool " Flames Give Rise to " Normal " Flames. Part III. The Physical Characteristics of the Two-Stage Process Ignition of Ether–Oxygen Mixtures. M. Maccormac and D. T. A. Townend. *J. chem. Soc.*, Feb. 1940, 143–150.—It has been shown previously by these authors (*vide J. chem. Soc.*, 1939, 337, 341) that with ether–air mixtures the two-stage process of ignition could be observed in cold media at high enough pressures.

In this paper are given the results of an investigation using ether–oxygen mixtures under these conditions. From experiments carried out at constant pressure, and the fact that the " blue " gives a greater volume of products than the " cool " flame, the " blue " flame is now recognized as having characteristics differing from both the " cool " and normal flames. E. H. W.

832.* Examination of the Mechanism by which " Cool " Flames give Rise to " Normal " Flames. Part IV. The Chemical Character of the " Blue " Flame Initiated in the " Cool " Flame Products of Ether–Oxygen Mixtures. M. Maccormac and D. T. A. Townend. *J. chem. Soc.*, Feb. 1940, 151–156.—A new method for examining the gaseous products of flames is described. The products of " cool " and " blue " flames were analyzed, and differences between the two flames are shown. Much larger amounts of aldehydes and peroxides were produced by the " cool " flame, these compounds being decomposed in the " blue " flame. Acetaldehyde is said to play an important part in both " cool " and " blue " flames, and further examination of ether is being deferred until a similar detailed study of acetaldehyde itself has been made. E. H. W.

833.* Studies in Water-in-Oil Emulsions. Part III. The Effect of the Relative Phase Volumes on the Type of Emulsions Stabilized by Magnesium Oleate. R. C. Pink. *J. chem. Soc.*, Feb. 1940, 211–212.—Discrepancies in the results published in the literature prompted this author to make a detailed investigation of the effect of the ratio of the phase volumes on the type of emulsion produced. It was found that the method of preparation affected the type of emulsion to a certain extent. On standing there was a decrease of stability, and some of the emulsions with a higher concentration of soap underwent a reversal of type. E. H. W.

834.* Polycyclic Aromatic Hydrocarbons. Part XXII. C. L. Hewett. *J. chem. Soc.*, March 1940, 293–303.—Derivatives of phenanthrene with substituents in at least three of the 1-, 2-, 3-, or 4-positions are carcinogenic. 1 : 2-Dimethylchrysene should therefore be active. A synthesis of this compound is described, and in the biological tests now progressing activity has already been shown. Further, in these phenanthrene

derivatives, benzene rings may be interchanged with methyl groups without loss of activity. Hence a synthesis of 1 : 2 : 3 : 4-tetramethylphenanthrene was attempted. This, however, was unsuccessful, 1 : 2 : 3 : 4-tetramethylanthracene being produced instead. In order to study the effect on the carcinogenic activity of the size of the 2-substituent in 3 : 4-benzphenanthrene, 2-*iso*propyl-3 : 4-benzphenanthrene was synthesized, a new method being devised. This compound has not yet been assessed for activity. E. H. W.

835.* Polycyclic Aromatic Hydrocarbons. Part XXIII. J. W. Cook and (Mrs.) A. M. Robinson. *J. chem. Soc.*, March 1940, 303–304.—Carcinogenic properties are shown by 5-methyl, 5-ethyl, 5-*n*-propyl, and 5-*n*-*iso*propyl derivatives of 1 : 2-benzanthracene. To determine whether increase in the length of the carbon chain would cause any change in activity, 5-*n*-butyl, 5-*n*-amyl, 5-*n*-hexyl, and 5-*n*-heptyl derivatives were prepared. These new homologues of 1 : 2-benzanthracene are undergoing biological tests, and preliminary results suggest that there is a steady decline in carcinogenic activity with increase in length of the side chain. E. H. W.

836.* Solvent Effects with Optically Active Saturated Hydrocarbons. A. W. Pryde and H. G. Rule. *J. chem. Soc.*, March 1940, 345–347.—These authors have extended the work done on *d*-pinane by Rule and Chambers (*vide J. chem. Soc.*, 1937, 145) by making similar measurements on *l*-dimenthyl, *l*-dibornyl, and *d*- and *l*-*iso*camphane in a variety of non-polar solvents.

In no case was a simple relation between the optical activity and the refractive index found, but the relation previously observed with *d*-pinane is shown to be fortuitous. E. H. W.

837. Physical Properties of Purified 2 : 2 : 3-Trimethyl-Pentane. D. B. Brooks, F. L. Howard, and H. C. Crafton, Jr. *Bur. Stand. J. Research* (*Wash.*), 1939, **23** (6), 637–641.—In connection with an investigation of paraffin hydrocarbons as aviation fuel constituents, a sample of 2 : 2 : 3-trimethylpentane was prepared synthetically and after fractionation was obtained in a state of great purity.

Methylethyl-*tert.*-butylcarbinol was refluxed with about 0·5% iodine and the mixture of resulting olefins was recovered by distillation, dried with $CaCl_2$, refluxed with Na, and fractionated in a 100-by-2 cm. column. The portion, b.pt. 107–114° C., was hydrogenated, washed with H_2SO_4, water, $NaHCO_3$, and then three times with water. It was then dried, distilled from Na, and fractionated.

The resulting product was of such purity that a good freezing point was obtained. The freezing point and melting point were determined in an apparatus in which the rate of cooling or heating could be accurately controlled. Other properties measured included the boiling point and its variation with pressure, refractive index and density and their variations with temperature. D. L. S.

838. Physical Properties of Some Purified Aliphatic Hydrocarbons. D. B. Brooks, F. L. Howard, and H. C. Crafton, Jr. *Bur. Stand. J. Res.* (*Wash.*), 1940, **24** (1), 33–45.—The hydrocarbons discussed in this paper were prepared in connection with an investigation of the suitability of various paraffins as constituents of aviation fuel. Eight were synthesized, one was isolated by fractionation from a commercial synthetic crude, and two were obtained from commercial sources. All were further purified by distillation in fractionating columns of high efficiency.

3 : 3-Dimethylbutene-1, 2 : 3-dimethylbutene-1, and 2 : 3-dimethylbutene-2 were synthesized, commencing with acetone and magnesium amalgam to form pinacol hydrate, converting this into pinacolone and then by refluxing with Na to pinacolyl alcohol. Dehydration of the alcohol yielded a mixture of olefines from which the desired hydrocarbons were separated by distillation.

2 : 2-Dimethylbutane was prepared from 3 : 3-dimethylbutene-1, and 2 : 3-dimethylbutane from 2 : 3 : dimethylbutene-2 by hydrogenation under pressure.

2 : 3 : 3-Trimethylbutene-1 was synthesized from acetone and *tert.* butyl magnesium chloride, yielding 2 : 3 : 3-trimethylbutanol-2, which on dehydrating formed the desired olefine. This was also hydrogenated to give 2 : 2 : 3-trimethylbutane.

3-Ethylpentane was synthesized from triethylcarbinol formed by the action of ethyl propionate on ethyl magnesium bromide. Triethylcarbinol, on distilling slowly

in the presence of 0·5% iodine, yielded the olefine which on hydrogenation gave the desired paraffin. 2 : 3 : 4-Trimethylpentane was prepared by fractionation of a mixture of isomeric octanes, whilst *n*-heptane and 2 : 2 : 4-trimethylpentane were carefully fractionated from purest batches of the certified hydrocarbons.

These products were examined and the following physical properties determined: freezing point, boiling point and its variation with pressure, refractive index and density and their variations with temperature. D. L. S.

839. Chemistry and Physics Patents. F. M. Clark. U.S.P. 2,191,338, 20.2.40. Appl. 7.7.38.—Stabilized mineral oil is produced by incorporating with the oil about one-tenth to 3% of wood resin.

U. B. Bray and C. E. Swift. U.S.P. 2,191,091, 20.2.40. Appl. 4.8.31. Treatment of oil by dilution with a liquefied normally gaseous hydrocarbon diluent and maintaining the diluted oil under sufficient pressure to keep the hydrocarbon diluent in a liquid state. Thereafter the oil plus diluent are clay-treated and separated from each other.

J. P. Loumiet. E.P. 517,550, 1.2.40. Appl. 29.7.38. Protracted and intimate contact is obtained between two non-miscible fluids of different densities by causing them to travel jointly and at great velocity along a curved tubular path. The centrifugal force developed by the curvature of the path and the velocity of the fluids separates them laterally to the path, the denser one being outward and the lighter one inward with respect to the centre of curvature. The relative positions of the two liquids are subsequently inverted and the process repeated at frequent intervals.

T. A. Clayton. E.P. 518,158, 19.2.40. Appl. 12.1.39. Preservation of oils, rubber, and other oxidizable substances by the incorporation of a diarylamine compound having at least one of the hydrogens of at least one of the aryl rings substituted by an alkenyl-oxy group.

Ruhrchemie A.-G. E.P. 518,334, 23.2.40. Appl. 8.9.38. Production of cobalt and magnesium catalysts for use in the catalytic conversion of carbon monoxide and hydrogen. When using solutions of the nitrates or chlorides of cobalt and magnesium it has been found effective to employ a magnesium solution, the magnesium content of which is greater than that corresponding to the stoichiometric proportion of magnesium to cobalt in the catalyst to be produced.

Socony-Vacuum Oil Company, Inc. E.P. 519,371, 26.3.40. Appl. 20.8.38. Apparatus for alternately effecting catalytic conversion of hydrocarbons and regeneration of the catalyst. The apparatus comprises a number of heat-transfer surfaces in spaced relation within a container or converter in which a reaction material is brought into contact with a catalyst mass. H. B. M.

Analysis and Testing.

840. Quantitative Analysis of Gaseous Hydrocarbons by Adsorption and Desorption. E. Ferber and H. Luther. *Angew. Chem.*, 1940, **53**, 31–35.—The separation of gaseous paraffinic hydrocarbons by fractional distillation is clumsy and slow. The authors have devised a method of adsorption and desorption with active charcoal and other adsorbents, selected according to the materials treated. In this way they have separated the hydrocarbons into binary mixtures, after which further analysis was easy. E. W. S.

841. New Physical Chemical Method for the Determination of Constituents in Mixtures, and its Application to Mineral Oils, Synthetic Oils, and Tar Fractions. G. Ibing. *Angew. Chem.*, 1940, **53**, 60–65.—The method, based on theoretical reasoning, produces highly practical results. According to Raoult's law it is possible to find the concentration of solutions by very accurate measurements of the freezing point. The conditions for this are that the molecular weight of the dissolved constituent must be accurately known, and that there must be a true atomic solution. It is

shown that with the new method it is comparatively easy to make analyses hitherto regarded as being very difficult, *e.g.*, determination of the benzol content in technical spirits, condensed aromatic hydrocarbons in fuels, etc. E. W. S.

Motor Fuels.

842. Co-operative Fuel Research Motor Gasoline-Survey, Summer 1939. E. C. Lane. U.S. Bureau of Mines: *Report of Investigations* 3492, Feb. 1940.—This report concerns the properties of commercial motor fuels, and has been compiled through the co-operation of the Co-operative Fuel Research (C.F.R.) Committee and the U.S. Bureau of Mines. It deals with 1679 different samples of motor fuel, representing the products of over 100 oil companies in the United States. The data are grouped together under three main headings—premium, regular, and third-grade gasoline—and include results of determinations of specific gravity, sulphur content, Reid vapour pressure, A.S.T.M. octane number, and distillation characteristics, the latter being corrected to sea-level. Comments are offered on the copper-strip corrosion test, which was apparently only positive in a single sample of third-grade fuel; on the octane number, wherein it appears that 90% of the regular is higher and wider by one octane number for 1939 summer than for the corresponding period in 1938, being virtually unchanged in the case of the premium grade, but up to 4·5 higher in 1939 for the third-grade gasoline. In the matter of volatility, the ranges of vapour pressures, in which 90% of the samples of each grade fall, show practically no change in level and spread for 1939 compared with corresponding samples examined in 1938 summer. Temperature ranges in distillation for regular and premium grades are essentially unchanged in 1939, though the middle range of temperatures for third-grade fuel is appreciably lower than was found in the 1938 survey. H. B. M.

843.* Distillation Curves of Blends. W. L. Nelson. *Oil Gas J.*, 29.2.40, **38** (42), 64.—It is shown that the boiling range of intermediate distillation products can be computed from true boiling-point curves of the crude oils, but the A.S.T.M. distillation curves are very misleading for this purpose. Examples are given of the T.B.P. curves of a gasoline and a fraction from it, showing that the two curves lie along the same line, with the exception of a few per cent. at the initial and final parts of the curve of the fraction, where the fractionation is necessarily inadequate. Similar curves are reproduced for gasoline from a crude oil and of a blend of three gasoline components. C. L. G.

844.* National Motor Spirit. Report by Government Commission, Argentine. Anon. *Bol. Inform. Petroleras*, Dec. 1939, XVI (184), 19–23.—The Commission came to the conclusion that the fuel to be recommended would be a mixture of 20–30% of absolute alcohol and 80–70% of petrol, which would be suitable for I.C. engines. The alternative use of etherized alcohol is not recommended, as in that case the proportions of the mixture are limited to 30% and 70%, respectively. The alcohol would be denatured by the addition of 3% of *iso*propanol. Full particulars of tests are given. H. I. L.

845. Patents on Motor Fuels. T. W. Bartram. U.S.P. 2,193,666, 12.3.40. Appl. 14.9.37.—Cracked hydrocarbon motor fuel of the type which tends to deteriorate on storage, as evidenced by colour and gum formation, is treated with a small proportion of a sulphurized diaryl arylene diamine. The latter is obtained by reacting a sulphur halide and a diaryl arylene diamine in the presence of a substantially inert solvent at a low temperature.

D. B. Macdonald. E.P. 518,958, 12.3.40. Appl. 2.9.38. The properties of fuels for internal combustion engines are improved by the addition of compounds soluble in the fuel concerned and having a porphyrine nucleus.

D. B. Macdonald. E.P. 519,408, 26.3.40. Appl. 17.8.38. Method of improving the properties and/or combustion of liquid fuels consisting wholly or partly of hydrocarbons by the addition of bone oil with or without additional substances, such as sterols, anhydrous lanoline, and phosphatides. H. B. M.

Lubricants and Lubrication.

846.* Superfinish. D. A. Wallace. *J. Soc. Aut. Engrs*, 1940, **46** (2), 69–92.—Superfinishing is a new method of finishing metal surfaces. The tool used is a bonded abrasive in which the relatively coarse grits are firmly embedded; hence, only the cutting points of the grits are available to remove material from the surface to be treated. The work is rotated and the abrasive block pressed against it with an oscillating motion, the object being to ensure that no particle of abrasive follows the same path twice. The method is characterized by low abrasive speed, low pressure, and low surface temperature. It is claimed that, whereas all accepted production methods of surface-finishing leave a micro-layer of amorphous and fragmented material, superfinishing forms a crystalline surface of great smoothness. The necessity of "running-in" rubbing surfaces is thus avoided, and the optimum clearances can be established during manufacture. Other advantages are the ability to carry greater loads without breakdown of the oil film, and reduced wear.

In some tests on the S.A.E. oil-testing machine, a ground surface having a smoothness of 13·5 micro-in. (profilometer reading) caused failure with a particular lubricant at 111 lb. By superfinishing to 2 micro-in. the same oil only failed at 217 lb. By a modification of the same machine it was demonstrated that initial wear was much reduced by superfinishing. The process has been successfully applied to many automobile components during the past two years; among other advantages it is stated that crankcase sludge is reduced, since the primary cause of sludge formation has been metallic particles worn off lubricated surfaces. K. A.

847. Patents on Lubricants. W. L. Evers. U.S.P. 2,188,943, 6.2.40. Appl. 28.12.35. Production of an extreme pressure lubricating composition consisting of a hydrocarbon lubricant and a small portion of triaryltrithiophosphite.

H. Goethel, H. Tramm, and P. Schaller. U.S.P. 2,190,918, 20.2.40. Appl. 5.7.35. The characteristics of lubricating oil are improved by the addition of a substantial proportion of a polymerization product of propylene. The said product is obtained by treating propylene-containing material under super-atmospheric pressure and at a temperature of approximately — 30° C. in the presence of a polymerization catalyzer, long enough to permit the greater part of the reaction to take place, after which the temperature is raised to room temperature under increased pressure to complete the reaction.

S. E. Jolly. U.S.P. 2,190,715, 20.2.40. Appl. 16.1.37. Production of an extreme pressure lubricant consisting of a lubricating oil containing a minor percentage of alkyl benzene dichlorphosphine in which the alkyl group contains from three to four carbon atoms.

C. L. Ocon. U.S.P. 2,191,972. 27.2.40. Appl. 1.11.37. Recovery of high-quality lubricating oils from inferior oil stocks by subjecting the latter to a de-asphaltizing process, dewaxing the oil which has been de-asphaltized, and selectively separating these from a relatively more paraffinic fraction. The relatively less paraffinic constituents are extracted and subjected to differential separation by means of normally liquid aliphatic hydrocarbons boiling above 400° F., mixed with a solvent medium for alkyl compounds.

W. B. McCluer. U.S.P. 2,191,767, 27.2.40. Appl. 15.12.34. Process for extracting a lubricating oil of Pennsylvania grade by mixing with the oil a solvent which is selective as to molecular type and which is furthermore completely miscible with the oil. Subsequently, the mixture is contacted with a second solvent which is selective as to the same molecular type as the first solvent, but which is relatively immiscible with the oil although completely miscible with the first solvent. The first solvent is scrubbed from the oil by the second solvent.

L. B. Turner. U.S.P. 2,192,700, 5.3.40. Appl. 20.5.38. Production of an improved lubricating oil comprising a hydrocarbon oil and an organic sulphur compound prepared by reacting a halogenated compound having an aliphatic chain with a sulphide so as to replace the halogen with sulphur.

O. P. Puryear. U.S.P. 2,193,771, 12.3.40. Appl. 6.10.37. Production of a lubricating oil composed of petroleum lubricating oil and the product resulting from heating together sperm oil, lanolin, and sulphur to temperatures of about 320–330° F. to form a sulphurized-oil lanolin base.

F. R. Mosel and D. R. Nijk. U.S.P. 2,194,478, 26.3.40. Appl. 2.8.37. Manufacture of a non-halogenated compounded lubricant comprising a mineral lubricating oil and from 1–10% of an organic compound having at least 2 *iso*cyclic 6-carbon rings in close proximity to each other and at least 2 hydroxyl radicals separated from the rings by not more than 1 carbon atom.

A. C. G. Egerton. U.S.P. 2,195,167, 26.3.40. Appl. 30.6.38. Prevention of formation of gum-like products in lubricating oils subjected to the action of an atmosphere containing oxides of nitrogen in an internal combustion engine. A gum inhibitor comprising a urea derivative containing at least two alkyl groups is introduced into the oil.

R. Priester. U.S.P. 2,195,225, 26.3.40. Appl. 25.10.38. Manufacture of a drying oil from castor oil by heating it at a temperature between 150 and 250° C. in the presence of a small amount of a sulpho compound of a lower aliphatic hydrocarbon.

B. H. Shoemaker. U.S.P. 2,195,659, 2.4.40. Appl. 6.2.37. Preparation of a sludge-resistant mineral oil comprising a highly refined mineral oil, normally susceptible to the formation of excessive sludge and the development of high acidity, and a small amount of extract obtained from the solvent extraction of uncracked mineral oils.

E. C. Carmichael, R. J. de Gray, and J. H. Prall. U.S.P. 2,196,101, 2.4.40. Appl. 23.9.38. Improved mineral lubricant oil compositions embodying a major portion of a viscous mineral lubricating oil fraction and a minor proportion of a nitrated fatty oil.

H. G. Berger, R. C. Moran, and F. M. Seger. E.P. 519,288, 20.3.40. Appl. 13.10.38. Manufacture of a composition suitable for addition to mineral lubricating oil to enable it to withstand extreme pressures. A part only of the chlorine in chlorinated aliphatic hydrocarbon material is chemically substituted with a thiocarbonate group. H. B. M.

Asphalt and Bitumen.

848.* Temperature Susceptibility of Asphaltic Bitumen. D. C. Broome, *Petroleum*, Feb. 1940, **1** (4), 126.—Reference is made to the number of methods in existence for measuring the temperature susceptibility of asphaltic bitumens, and their relative values are discussed. The American methods, based on penetrations at different temperatures, using different times and weights, are considered unsound owing to the varying stresses, since many bitumens are of plastic nature. The Pfeiffer and van Doormal penetration index is based on an assumption that the penetration at the ring and ball melting point is 800, which is frequently not the case. The effect of stress is shown by a series of ductility figures carried out on different rates of pull. The Continental method of determining the plastic range by the temperature difference between the breaking point (*e.g.*, Fraass) and the softening point is of practical value. Abraham's method, based on the penetration at 32° F. and 115° F. and the softening point, as well as Kelly's float test index, suffer also from the difficulty of reconciling figures obtained at varying stresses. Considerably sounder theoretically are the number of methods based on rate of change of viscosity with absolute temperature, it being emphasized that the viscosity determinations should be carried out at the same rate of shear. The susceptibility of bitumens is reduced by the presence of a high asphaltene content, or by mineral matter, and increased by the presence of oily constituents. With oxidized bitumens, the temperature susceptibility is low over the medium range, but they frequently tend to be brittle at low temperatures and exceptionally fluid at high temperatures. C. L. G.

849. Patents on Asphalt and Bitumen. Ebano Asphalt-Werke A.-G. E.P. 518,655, 4.3.40. Appl. 1.9.38. Preparation of bituminous materials having high resistivity

against heat and cold and a low viscosity by blowing asphalt-free viscous mineral oil distillates of crude asphalt-base oils with air at temperatures between 160 and 200° C. for 30–200 hr. The products are suitable for use as binders, saturants, and adhesive compounds.

Standard Oil Development Co. E.P. 519,119, 18.3.40. Appl. 15.9.37. The adhesivity of bituminous compounds can be increased by heating with a metal oxide so that the acidic compounds present are converted to metal soaps.

H. Marc. U.S.P. 2,188,204, 23.1.40. Appl. 24.1.36. Bituminous composition composed of 35–75% asphalt having a softening point between 150 and 300° F., a petroleum solvent, up to 15% dipentene and 1–10% resin derived from cumene and indene.

J. A. Montgomerie and P. K. Archibald. U.S.P. 2,190,604, 13.2.40. Appl. 16.5.38. Preparation of a slow-breaking bituminous emulsion from difficultly emulsifiable pyrogenous residue of organic substances when the residue is not emulsible in dilute aqueous alkali alone.

H. Dohse and F. Spoun. U.S.P. 2,191,295, 20.2.40. Appl. 27.10.36. Bituminous and solid substances used in road materials are brought together in the presence of an adhesive selected from the group consisting of cation-active organic derivatives of ammonia.

L. Kirschbraum. U.S.P. 2,194,428, 19.3.40. Appl. 30.12.36. Construction material composed of flexible fibrous felt saturated with a binder. The felt base carries a coating of asphalt in which is incorporated an oil-diffusing substance to retard hardening of the coating on exposure.

K. C. Laughlin and H. E. Cier. U.S.P. 2,195,536, 2.4.40. Appl. 31.12.35. Manufacture of a light coloured asphalt from an asphaltic oil by adding liquid propane to the residuum of an asphaltic crude oil. The temperature is raised to 80–150° F. and the precipitate thereby formed separated off. The remaining solution is treated with sulphuric acid and the acid thereafter removed. On raising the temperature again to 20–130° F. a second precipitate of a light-coloured asphalt is obtained.

A. B. C. Dahlberg. U.S.P. 2,192,284, 5.3.40. Appl. 24.3.36. Mineral road aggregate of an acid character is bituminized by applying to the aggregate when wet a layer of slaked lime. The lime is allowed to react on the aggregate for at least 15 minutes and then oleic acid is applied to the coated aggregate to form water-insoluble soaps. The bituminous binder when applied forms a close cohesion to the soaps and thus to the mineral aggregate. H. B. M.

Special Products.

850. Patent on Special Products. Consortium fur Electrochemische Industrie, G.m.b.H. E.P. 418,220, 19.3.40. Appl. 4.10.38. In the production of carbon tetrachloride, perchlorethylene vapour is led to a reaction space heated to 700–800° C., and through which chlorine flows simultaneously. After partial conversion, it is fed to the middle part of a fractionating column, from the upper part of which the carbon tetrachloride formed distils off while the perchlorethylene condenses in the lower part.

B. Buxbaum. E.P. 518,664, 5.3.40. Appl. 24.5.38. Mineral oil is improved by the admixture therewith of a paste comprising colloidal sulphur and an oily, fatty or aqueous vehicle. The particle size of the sulphur is less than 5 μ.

Societa Italiana Pirelli. E.P. 519,603, 1.4.40. Appl. 4.1.39. Improvement in the manufacture of electric cables of the constant-volume type having an oil-impregnated insulation. The oil or compound used to impregnate the insulation is not ordinarily gasogenic, but is rendered so by the addition of a gasogenic substance liquid at normal temperatures, and having a vapour pressure higher than that of the most volatile component of the oil or compound. H. B. M.

Detonation and Engines.

851.* High-Output Aircraft Engines. E. W. Hives and F. Ll. Smith. *J. Soc. Aut. Engrs*, 1940, **46** (3), 106–117.—The authors contend that indirect or liquid-cooled engines are better adapted to the future trend of aircraft design than the direct or air-cooled type. The liquid-cooling system is now straightforward and absolutely reliable. The introduction of 100-octane fuel afforded temporary relief from detonation problems, but these are once more looming up again. A substantial gain in limiting B.M.E.P. is obtainable by injecting water into the manifold, but this is not considered a very practical way of increasing specific power output. Data are quoted showing the effect on specific output of improving blower efficiency and of using a two-stage blower with intercooler.

A new theory is advanced in explanation of the hot corrosion of exhaust valves by leaded fuels. The stellite coating of exhaust valves has not proved entirely satisfactory, and an 80/20 nickel-chromium alloy has proved more resistant to lead attack under severe conditions.

Lead-bronze bearing materials are troublesome in production, and the trend towards more powerful units is rendering improved bearings imperative. The Rolls-Royce Laboratories have developed aluminium–tin alloys having superior mechanical properties and less tendency to seize under conditions of restricted lubrication.

Other items discussed in the paper include interchangeable power plants, sleeve valves, liquid cooling systems, and ejector exhausts. K. A.

852.* Running Petrol Engines on Coal Gas. Anon. *Engineer*, 16.2.40, **149** (4388), 168–169.—The conversion of a petrol engine to run on town's gas can readily be made by the use of the gas carburettor described, which was designed primarily for running-in engines after assembly, but is equally suitable for traction purposes with engines developing up to 18 B.H.P. For engines of greater horse-power larger carburettors are available.

In this design suction of the engine automatically induces admission of air and gas through the medium of a spring-controlled piston, an adjustment being provided so that the carburettor can be set to give mixtures of different air–gas ratio and to allow for district variations in gas quality.

The maximum power output of a converted engine is stated to be about 12% lower than that obtained on petrol, while the gas consumption is between 25–30 cu. ft. per B.H.P. per hr.

Although the volume of gas which can conveniently be carried by a vehicle in a low-pressure gas bag limits its range to between 10–20 miles, it is pointed out that for town work, such as goods delivery, this mileage should be adequate, assuming sufficient filling stations to meet normal requirements could be readily made available. It has here been assumed that the high-pressure cylinder storage system with its greater capacity would not be extensively developed in the present emergency owing to the capital outlay on the necessary compression plant and other specialized equipment.

The cost of running on town's gas is anticipated to be lower than on petrol, and marked economy is obtained on slow running; furthermore greater ease of starting is secured. E. F. C.

853.* The Kadenacy Engine. Anon. *Engineering*, 23.2.40, **149** (3867), 195–197.—The object of the Kadenacy system is the improvement in the efficiency of two-stroke-cycle oil engines. The basic principle involved is utilization of the depression in the cylinder caused by rapidly opening the exhaust ports during the expansion stroke to secure an enhanced air charge. To obtain maximum efficiency it has been found that the exhaust system should bear a definite relation to the valve timing, and it is recommended that the exhaust system be matched up to the engine with a convenient arrangement of exhaust pipe and silencer.

The simplicity of the Kadenacy system is shown by the fact that it can be employed in the majority of existing engine designs without the necessity for basic alterations by modifications to the valve timing and port areas. Still further improved performances have been experienced by Messrs. Armstrong Whitworth Securities Co., Ltd., in engines specially designed to operate on the system, and two such examples are described and

illustrated in detail. The single-cylinder model designed for general industrial purposes is of 437 c.c. capacity and develops 5 B.H.P. at 1000 r.p.m., corresponding to a B.M.E.P. of 73·9 lb./sq. in. The six-cylinder engine is of 7·07 litres capacity, the rated output being 118 B.H.P. at 1200 r.p.m., giving a B.M.E.P. of 90 lb./sq. in. This engine, however, unlike the single-cylinder model, is fitted with a Roots-type blower, supplying in normal operation air at 2 lb./sq. in.

In both engines the combustion chamber consists mainly of a spherical recess in the piston top with partly conical sides, the main portion of the upper surface of the combustion chamber being formed by the head of the mechanically operated overhead exhaust valve. Tangentially arranged inlet ports cause a pronounced rotational swirl of the incoming air, which, combined with the movement set up on compression by the specially shaped piston top and underside of the cylinder head, promotes good fuel distribution and combustion. The injector is carried in the cylinder head, and is placed so that the spray enters the combustion space tangentially and with a slight downward angle towards the centre. E. F. C.

854. Prospects of C.I. Engines. L. Keuleyan. *Aircr. Engng*, 1940, **12** (132), 43.—Although both the four- and the two-stroke cycle C.I. engine will have their application in aviation, it is the author's opinion that since the highest specific power is required from a given weight, only the two-stroke cycle engine can compete favourably with a modern petrol aircraft engine.

The results of several series of tests carried out in the U.S.A. are presented as evidence of the possibilities of the C.I. aero-engine. In a single-cylinder four-stroke cycle engine smooth operation without combustion shock was obtained under boosted conditions, and fuel consumptions of 0·39 lb./h.p./hr. were recorded with I.M.E.P.'s of 240 lb./sq. in. and at 2060 r.p.m. Other experimenters claim that the four-stroke cycle C.I. engine, with the present technique of combustion control, can attain lower specific fuel consumption than the lowest obtainable from the petrol engine using 100 octane fuel to maximum economy advantage. The altitude performance of the oil engine will also be fully equal to that of the petrol engine.

As regards the two-stroke cycle oil engine, performances obtained with the uniflow single-cylinder $4\frac{1}{2} \times 7$ in. engine with piston-controlled inlet ports and poppet exhaust valves were highly satisfactory and have equalled German performances.

The writer concludes by illustrating the very high grade of development achieved in the two-stroke cycle field by the Junkers C.I. engines. The main contributory factors have been increase in engine speed and scavenging efficiency and the use of an exhaust-gas turbine which is claimed to increase the power output by more than 25% without raising fuel consumption. E. F. C.

855. Examination of the Knocking Sound in Otto Engines with Electro-Acoustic Equipment. A. W. Schmidt and K. Generlich. *Z. ver. dtsch. Ing.*, 1940, **84**, 48.—The authors have developed electro-acoustic instruments and have made tests with them since 1934, reaching a final stage in 1939.

By means of the instrument described it is possible to plot diagrams from which may be seen not only the commencement of knocking, but also the intensity of the knock. It is hoped to introduce a more exact knocking index than the octane number of to-day. With the equipment described it is also possible to determine the knocking rate in ordinary engine cylinders even simultaneously on all six cylinders of an engine during actual operation. E. W. S.

856. Tests of the Power Output of an Internal Combustion Turbine. A. Stodola. *Z. ver. dtsch. Ing.*, 1940, **80**, 17–19.—The author was able to make tests with the first turbine running in actual operation by internal combustion of liquid fuels, and to measure the thermal efficiency. The turbine is installed in a bomb-proof power station in Switzerland, and is apparently using gas oil or diesel oil as fuel. The thermal efficiency is about 18%. It is considered possible even to-day to bring about a material increase in the efficiency. The engine is used for emergency power, and is especially adapted for this purpose because of the small space required. The turbine requires no boiler and no cooling water, and there is practically no consumption of lubricating oil. E. W. S.

Coal and Shale.

857. Correlation of Analysis of Coal with the Products of Carbonization in Externally-heated Retorts. V. F. Parry. U.S. Bureau of Mines: *Report of Investigations No.* 3482, Dec. 1939.—Certain coals with similar chemical composition, as revealed by analysis, act differently in a given retort, and the products of carbonization may accordingly differ. It is for this reason that the commercial carbonization of coal to produce coke and by-products has developed largely as an art based on experience, and not as a science. The object of the present investigation was to correlate the results of experimental carbonization with the properties of the coals tested. The following conclusions were reached after correlating the results of carbonization tests of 125 coals with their analyses. The amount of tar that will form in the retort is directly proportional to the square of the oxygen-free volatile matter contained in the coal, and inversely proportional to the absolute temperature of carbonization. The amount of water which will form during destructive distillation at low temperatures is directly proportional to the oxygen content of the coal raised to the 1·3 power. The amount of gas in B.T.U. per pound of coal is directly proportional to the volatile heating value, and inversely proportional to the square of the volatile matter in the coal. The amount of coke resulting from carbonization is the sum of the fixed carbon plus ash, plus a factor "R." Factor "R" is defined as the percentage of the original coal that remains in the coke as a product of decomposition from volatile matter in the coal. H. B. M.

858. Patent on Coal. H. Koppers. U.S.P. 2,194,359, 19.3.40. Appl. 7.4.37. Process for improving the yield of valuable hydrocarbons in the low-temperature gaseous products evolved in retort ovens during low-temperature carbonization of a coking charge at a temperature below 750° C. by externally applied coking heat to produce gas and coke. H. B. M.

Economics and Statistics.

859. Crude Petroleum and Petroleum Products, November 1939. Anon. U.S. Bureau of Mines: *Monthly Petroleum Statement No.* 192.—In November 1939 production of crude oil in the United States reached the highest level in history, the daily average being 3,729,600 brl., as compared with the previous record of 3,723,000 brl. in August 1937. Daily averages in November 1939 were higher than those for the previous month in most States, though production in California and Illinois showed a slight decline. Averages for Michigan (68,200 brl. daily) and Louisiana (200,000 brl. daily) established new production records. During November 1939 crude oil stocks also increased by nearly 3,000,000 brl., this being the first gain since last April and reflecting chiefly declines in runs to stills and in exports. Gasoline yields during the month under review reached a new peak of 45·8%. Residual fuel oil was the same as in October, but light fuel oil showed a decline in yield from 13·5% in October to 13·1% in November. The Bureau of Labor Statistics records that the price index for petroleum products was 53·9 in November 1939, as compared with 54·0 in the previous month and 51·5 in November 1938. H. B. M.

860. Natural Gas Consumption Decreased in 1938. Anon. U.S. Bureau of Mines: *Mineral Market Report No. M.M.S.* 772, Dec. 1939.—In 1938 the marketed production of natural gas decreased for the first time since 1933, the decrease being approximately 5% from the peak of 2,407,620,000,000 cu. ft. reached in 1937. All the major classes of consumption, with the exception of field use, also showed a decrease, the largest being in miscellaneous industrial use. Large amounts of low-priced gas used in the field and in carbon-black manufacture, particularly in Texas and Oklahoma, were responsible for a decline in value of natural gas at the wells from an average of 5·1 cents in 1937 to 4·9 cents in 1938. Similarly, the average value at points of consumption declined from 21·9 cents in 1937 to 21·8 cents in 1938. 29% of total consumption in 1938 was used for field purposes, 16% for domestic purposes, 5% for commercial purposes, 14% for carbon-black manufacture, 7% as fuel in electric public-utility power plants, 5% in petroleum refineries, 2% as fuel in cement plants, and 22% for all other

industrial purposes. 53,770 gas wells were in use at the end of 1938, compared with 55,050 at the beginning of the year. 2236 wells were drilled during the year, which indicates that 3516 wells were abandoned or shut down during the year, as compared with 2284 in 1937. H. B. M.

861.* World Legislation on Petroleum. Anon. *Bol. Inform. Petroleras*, Dec. 1939, XVI (184), 66–75.—This is a continuation of a reference index to laws affecting the exploitation of petroleum in different countries and to literature published in that connection. The first of these records was published in No. 174 of this journal. This number includes, among others, Russia, Uruguay, and Venezuela. H. I. L.

862.* Economic Dynamics of the Domestic Demand for Motor Fuel. N. D. FitzGerald. *Petrol. Tech.*, Feb. 1940, A.I.M.M.E. Tech. Pub. No. 1174, 1–7.—Domestic motor-fuel demands rose from 226,000,000 brl. in 1925 to 522,000,000 brl. in 1938. Numerous influences are at work determining the expansion and fluctuation of demand for motor fuel. The primary components are the number of motor vehicles registered (R millions), the price of motor fuel to the consumer (P cents/gal., average in fifty large cities), the miles of hard-surfaced rods (H thousands), and the national income (N billion dollars). T is the number of years since 1924. The annual demand for motor fuel in millions of barrels is then given by

$$D = 17{\cdot}865R - 7{\cdot}199P + 0{\cdot}023HT + 0{\cdot}409N.$$

This equation conforms well with the actual data. Equations representing the separate effects of each component on the demand have also been derived.

There are secondary components affecting the demand, and of the primary components price alone is the demand-generating element over which the industry has some control. G. D. H.

863. Canadian Mineral Industry in 1938. Canada Dept. of Mines and Resources: *Mines and Geology Branch Bureau of Mines No.* 804, 1939.—Nearly 97% of the total Canadian output of petroleum is now obtained from the Turner Valley field in Alberta, in which there were sixty-eight producing wells at the end of 1938 and seventeen in process of being drilled. The main producing area lies in the southern part of the field, and has a proved length of nearly five miles and a width of two miles. The northern part of the field is about nine miles away, and as yet few wells have been drilled, though the area is attracting considerable attention. It is not known yet whether the intervening nine miles between the southern and northern parts of the field will prove to be productive, but should this be the case the Turner Valley field would have a proved length of some seventeen miles.

Small quantities of oil are also produced from the Red Coulee field, Wainwright, Ribstone, Taber, and Moose Mountain areas in Alberta. In south-west Ontario commercial quantities are produced at Petrolia, Oil Springs, Bothwell, Dawn, Warwick, West Dover, and Moser; in New Brunswick it is produced at a place about nine miles south-west of Moncton; and in the North-west Territories about fifty miles west of Great Bear Lake.

Production in the Turner Valley field throughout 1938 was prorated so that output should not exceed demand. In September this demand reached a peak of 862,413 brl. from the field, the daily production being placed at 28,300 brl. a day during the period 12th to 24th September.

In the southern part of the field, where the oil obtained is a light crude ranging from 40 to 50° A.P.I. gravity, thirty-eight wells were brought into production in 1938. In the northern area the completion of Home-Millarville No. 2 was important, as the favourable structure is known to extend for several miles to the north of the well.

During the year under review Canada exported $877,553 worth of petroleum and products and 4,987,879 Imp. gal. ($458,997 worth) of gasoline and naphtha.

Retail sales of gasoline in Canada amounted to 762,591,000 gal. in 1938. Turner Valley crude oil is used in practically all the refineries in Alberta, Saskatchewan, and Manitoba, and imports to these provinces were only slightly in excess of 500,000 brl. H. B. M.

BOOK REVIEWS.

Evaluation of Petroleum Products. Sponsored by Sectional Committee Z-11 on Petroleum Products and Lubricants; published by the American Society for Testing Materials. 1940. Pp. 52. Price 75 cents.

This publication contains six articles dealing with lubricating oils, petroleum lubricating greases, gasoline, diesel fuels, fuel oils, and aviation fuels and lubricating oils, and represents a valuable supplement to the A.S.T.M. publication on "The Significance of Tests."

The six papers review the present status of the testing of products and lubricants, mainly with reference to A.S.T.M. methods of test, and discuss what additional test methods are desirable in the future. Each paper presents a complete summary of the present position on the subject, referring to a number of sub-committees of the A.S.T.M. the work of which is still in progress, and gives a carefully selected list of references to the literature. The paper on gasoline by T. A. Boyd is perhaps outstanding and summarizes the connection between volatility of the fuel and performance in a car in a very simple and complete manner; knock characteristics, tetraethyl lead, gum content, sulphur, and specifications are similarly considered. S. D. Heron's article on aviation fuels and lubricating oils is particularly apposite at the present time, and includes a paragraph summing up the difference in point of view on knock testing in America and elsewhere, and suggests the desirable characteristics for a knock-testing method suitable for international acceptance.

The definition given in the article on lubricating oils—"The primary object of lubrication is to provide between bearing surfaces a film of a type that will permit the conversion and the use of power without large friction losses and without serious harm to the lubricated surface"—appears to be unduly cautious, as similarly the later statement that "Except under very mild operating conditions, the life of reciprocating parts is comparatively limited."

"Evaluation of Petroleum Products" is particularly valuable in that it provides a short, concise summary of the testing methods in relation to petroleum products (with the exception of asphaltic bitumens), and emphasis should be placed on the sub-title ("A Résumé of *Present* Information"). The views expressed on some of the test methods will undoubtedly require revision in the course of a year or so, in view of the concentrated research work being continually carried out on some of the problems to which reference is made.

The great value of this booklet is that an impartial estimate has been set forth by competent authorities on the basis of information at present available of the relation between behaviour in use—the real criterion—and laboratory test methods of petroleum products.

F. H. GARNER.

Collected Researches on Cylinder Wear. By C. G. Williams, with a foreword by the Rt. Hon. Lord Austin. Pp. 119. I.A.E. Automobile Research Committee, Brentford, Middlesex. Price 10*s*.

Although the Research Department of the Institution of Automobile Engineers has investigated numerous problems confronting the automobile industry during recent years, probably no aspect of its work has attracted such widespread interest as that devoted to cylinder wear. Ten years ago the automobile trade was seriously worried by the generally high rate of cylinder wear which curtailed the service life of engines. Much individual research was undertaken by manufacturers, but it was Mr. C. G. Williams and his staff who tackled the problem in a fundamental manner. From time to time the fruits of their researches were made available to Affiliated Manufacturers and Operators, and portions of their work have subsequently been reported in the I.A.E. Journal and other publications.

Now, for the first time, the whole series of Reports has been published in collected form, and this little volume should prove a handy work of reference. The Reports are given in order of publication, commencing with a "Discussion of Published Information on Cylinder Wear" (October 1931, 39 references), and a summary of "Experiences of Manufacturers and Operators." The First Interim Report, issued in March 1933, opens with a description of the single-cylinder engines and measuring apparatus used. Various operating conditions, popularly supposed to accelerate

wear, were studied, but by far the most important factor proved to be low cylinder-wall temperature. It was shown that the greatly accelerated rate of wear of cylinders and piston rings, which occurs when the cylinder-wall temperature is less than about 60° C., is associated with the condensation of water from the products of combustion. The "Corrosion Hypothesis" is further investigated in the Second Interim Report, wherein it is established that the guilty party is carbon dioxide—"an inevitable product of the normal combustion of every hydrocarbon," to quote the Foreword.

It was appreciated that, although *rate* of wear is abnormally high under low temperature operating conditions, abrasive wear cannot be ignored as a factor affecting total wear. Subsequent Reports deal primarily with the evaluation of many of the numerous factors affecting wear, such as mixture strength, load, clearances, ring design, and materials. There are some interesting tests on dirty oils, from which it would appear that the nature of the ash content is more important than the quantity. The influence of viscosity has also been studied in some detail; the beneficial effect of the lighter oils in rapidly establishing a lubricating film was readily shown by motoring tests on a cold engine.

That the information made available by the I.A.E. Research Department has alleviated the cylinder-wear problem is evident from a summary of "Recent Experiences of Manufacturers and Operators" (June 1937). The improvement was chiefly apparent in engines subject to frequent conditions of cold operation and which were, until recently, the worst offenders. However, the general level of wear still leaves room for further improvement, and it is satisfactory to learn that it is intended to pursue a continued methodical examination of the whole problem. K. ARTER.

Examen des Lubrifiants. By Emile Robbe. Pp. 128. Published by L'Usine, 15 Rue Bleue, Paris, 1937. Price 30 *frs.*

In these days, when the word co-ordination is on so many lips, a book such as this attracts an interest out of the common. There are eight chapters and two appendices. Appropriately, in the first chapter, a short introductory one, are some timely hints on correct sampling.

The second chapter concerns physico-chemical tests. The list is comprehensive enough, but the treatment with one or two notable exceptions is brief. As well as the usual tests, including viscosity, volatility, saponification value, Conradson carbon value, and resistance to heating, there are methods for estimating rubber and graphite. Viscosity determination is certainly brought up to date, but the space given to the only kinematic viscosimeter mentioned, the Baume Vigneron, is at the expense of the dismissal in a few lines of the commercial instruments. The method described for determining resistance to heating is the simple one of inserting a dish containing the oil in an oven for a given time, after which the loss of weight by volatilization is determined, and the heated oil examined for insoluble in chloroform and tendency to carbonization. This method is practically obsolete in this country.

Chapter Three is a short one devoted to the examination of used oils. Apart from the determination of diluent by steam distillation, the only other aspect treated is the composition of ash, methods being given for estimating silica, iron and aluminium, copper, zinc, calcium, and magnesium.

One page comprises Chapter Four on insulating oils, and this is solely concerned with the determination of dielectric strength.

Fatty oils are treated in Chapter Five. As well as the usual tests for iodine value and unsaponifiables, a few spot tests for the more common varieties are described.

Soluble cutting oils and pastes form the subject of Chapter Six. Outlines are given for their inspection for appearance, ease of emulsification, frothing tendency, action on metals, ash, resin, water, alcohol, and ammonia contents.

In Chapter Seven greases are dealt with, some methods, notably Ubbelohde drop point and Kiessling's method for consistency, being described in detail, a detail which seems superfluous in the case of density. One method, namely that for water content, uses xylene in the Dean and Stark apparatus. In addition to the determination of oil and soap contents, methods are given for the detection of sugar, amidon, and dextrin, as well as rosin and rosin oil.

The last chapter will probably interest most of all oil chemists and engineers alike, containing as it does some indications on the question of the practical testing of

lubricants. The aspects touched upon are friction testing, temperature rise in ball bearings, gear, and motor oils. In suggesting the use of an electric motor to drive the power unit and so save fuel, the important influence of the latter has apparently been overlooked.

The two appendices concern the recovery of solvents and the fitting out of a laboratory, respectively.

As an introduction to a more serious and detailed study of the subject, or for engineers concerned with controlling the purchase of oil to a specification, the book gives a broad outline unobscured by a mass of detail. J. L. TAYLOR.

BOOKS RECEIVED

Institution of Mechanical Engineers, Transactions, Vol. 142, July–December, 1939. 11″ × 8¾″. Pp. 503.

This volume contains several long Papers dealing with the engineering aspects of transport, which were to have been presented at the New York Meeting of the Institution, cancelled owing to the outbreak of war. "Motor Transport," by E. C. Ottaway, and "Problems of the Highway User in U.S.A.," by F. C. Horner, both contain much valuable economic data. Air transport is reviewed by A. Gouge ("Transatlantic Air Transport") and E. T. Allen ("Trend of Air Transportation"). The volume also contains the Thomas Hawksley Lecture by Sir Leonard Pearce on "Forty Years' Development in Power Station Plant."

Junior Institution of Engineers, Transactions, Vol. 49, 1938–39. 8¼″ × 5¼″. Pp. 572.

Papers on "Applications of Bitumen," by A. P. Morris, and "Surface Heat Exchangers," by R. Sutcliffe, are included among many Papers of general engineering interest. The Presidential Address of Sir Charles Bressey deals with "Roads and Traffic."

The Heavy Industry of Manchoukuo, pubd. by Japan Economic Federation, Tokyo. 7¾″ × 5″. Pp. 83 and map.

A short reference is included to the oil shale industry. The total deposits of oil shale in Manchoukuo are estimated at 7,600 million metric tons, most of which is deposited at Fushun, the rest being distributed in the Chientao, Sanshing and Jehol districts.

There is a directory of the principal mining companies in Manchoukuo.

A.S.T.M. Index to Standards, January, 1940. 9″ × 6″. Pp. 152.

Subject and numerical indexes of all standards and tentative standards included in the 1939 edition of A.S.T.M. Standards.

New South Wales, Geological Survey; Coal Resources of the Maitland–Cessnock–Greta Coal Districts. L. J. Jones. 9½″ × 5¾″. Pp. 225. 3 maps in pocket. Pubd. Sydney. 9*s*.

This Report of the N.S.W. Department of Mines is mainly concerned with the geology and mining development of the area. It contains also a summary of the report of the Director of Fuel Research, England, on the suitability for low temperature carbonisation and hydrogenation of samples from the Greta district.

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Geology and Development.

864. Geology and Coal Resources of the Minot Region, North Dakota. D. A. Andrews. *U.S. Geol. Surv. Bull.* 906-B, 1939.—It is reported in this bulletin that Fort Union rocks of Eocene age which crop out in the Minot Region of North Dakota have not so far been found to contain commercial quantities of oil and gas. The underlying Cretaceous rocks which yield oil in many localities in Montana and Wyoming are over 3000 ft. thick in the Minot area and have proved petroliferous in a well near Lonetree. They are, however, practically flat-lying, and structures usually favourable to the accumulation of oil or gas in commercial quantities are absent. Thus it is unlikely that notable quantities of oil or gas will be found. Little is known concerning the extent or possible petroliferous character of the older formations in the region, but it is probable that structurally they are similar to the Fort Union and Cretaceous rocks. H. B. M.

865. Mineral Industry of Alaska in 1938. P. S. Smith. *U.S. Geol. Surv. Bull.* 917-A, 1939.—This paper contains an account of the petroleum position in Alaska in 1938. In that year none was produced locally, and accordingly the ever-increasing demand for fuel and lubricants had to be met by imports from other parts of the United States. 45,785,418 gal. of crude oil, 9,441,726 gal. of gasoline, 326,970 gal. of illuminating oil, and 697,620 gal. of lubricating oil were imported in 1938. Comparison of these figures with those of earlier years reflects a tremendous increase in imports of heavy oils, due no doubt to the growing use of Diesel-equipped apparatus throughout the State. Gasoline imports were five times greater than in 1920, owing largely to the increased number of motor vehicles on the roads.

Search for new oil-fields in Alaska was again revived in 1936, and in 1938 was attracting considerable attention. Test wells were drilled in the Iniskin–Chinitna district on the west coast of Cook inlet, and at Bear Creek, north-east of Kanatak in Cold Bay. In the Iniskin area a depth of 7156 ft. was penetrated, the bottom of the hole probably reaching the Kialagvik formation, but the well on test died after flowing once or twice.

The conclusion was reached that the permeability of the formation was so low that the oil and gas could not readily escape into the hole. It is proposed, however, to continue tests at a later date and attempt to reach the base of the Kialagvik formation, where there is a sandstone member some 800 ft. thick which should form a good reservoir.

In February 1938 active work was begun in the Kanatak area, and showings of gas are reported to have been encountered during drilling. The work is being continued.

Apart from the drilling of actual test wells, geological investigations were in progress in 1938, in southern Alaska, notably at Controller Bay and Yakatago, where oil seepages have long been known. H. B. M.

866. Foraminifera, Diatoms, and Mollusks from Test Wells near Elizabeth City, North Carolina. L. G. Henbest, K. E. Lohman, and W. C. Mansfield. *U.S. Geol. Surv. Prof. Paper* 189-G.—In 1932 a number of test wells were drilled near Elizabeth City, North Carolina. The maximum depth penetrated was 482 ft. in one deep well, the others being sunk to depths between 25 and 93 ft. Beds penetrated were classified as follows: marine and brackish-water beds assigned to the Pleistocene; brackish-water beds assigned to the interval from Pliocene to Lower Pleistocene; and marine beds assigned to the Miocene. Samples were collected from each well as drilling proceeded and submitted to the Geological Survey for examination. A great many of these samples contained either foraminifera, diatoms, or mollusks, and their study forms the basis of the present paper. H. B. M.

867.* Winter Brings no Lull to Illinois Drilling. H. F. Simons. *Oil Gas J.*, 18.1.40, **38** (36), 11, 13.—The Salem field has been producing more than 180,000 brl./day from the Benoist, Aux Vases, and McClosky formations, and prolific production has been found in the Devonian Lime as well as good spotted production in the St. Louis Salem Lime. The twelve Devonian producers have had initial outputs of more than 3000 brl. each.

At Centralia a Devonian discovery has caused a revival, and Devonian production has also been obtained at Bartelso, Sorento, and Sandoval.

On the east side of the Illinois basin discoveries in the Chester series and in the McClosky have been important. At Storms the wells are big gas producers from the uppermost Chester.

Pipe-lines are being expanded to cope with the increased oil production.

G. D. H.

868. 254 New Oil-fields Discovered during 1939. Anon. *Oil Gas J.*, 25.1.40, **38** (37), 56–57.—The oil-fields discovered in U.S.A. during 1939 are listed and their positions are shown on a map. G. D. H.

869. Proven Reserves. Anon. *Oil Gas J.*, 25.1.40, **38** (37), 53–55, 218.—The estimated proven reserves in U.S.A. on 1st January, 1940, totalled 19,687,379,000 brl., an increase of 1,455,604,000 brl. during 1939. There were increases in the reserves in California, Texas, Louisiana, Illinois, and Arkansas, and Nebraska and Mississippi became producing States. Extensions to old and new fields far outdistanced new discoveries.

Details are given of the reserves at the beginning and end of 1939 for each State, the nature of the changes during the year—whether extensions or new discoveries, the production, etc. Where possible the acreage, formation thickness, etc., are given for the new proven reserves for individual fields. G. D. H.

870.* Oil Search in Georgia Covers Wide Front. A. C. Munyan. *Oil Gas J.*, 14.3.40, **38** (44), 24–26, 99.—The coastal plain of Georgia covers 60% of the total area, the crystalline area 35%, and the Palæozoic area of North-west Georgia 5%. The Palæozoic area is folded and faulted to such an extent as probably to preclude the retention of petroleum, except perhaps in the Cumberland plateau section. Gas may, however, occur.

The coastal plain outcrops range Upper Cretaceous to Recent. Much of the Upper Cretaceous is sandy at the outcrop, but down dip it changes to dark shale. The oil possibilities are undetermined. The Tertiary beds are briefly described. Overlaps are frequent. Many wells have been drilled for water, and the evidence they contribute shows that on the whole there is a gentle regional south-east dip, but there may be minor structures suitable for oil-traps. Definite traces of oil and gas have been noted in several recent wells. Palæozoic rocks have been proved beneath the Cretaceous, a fact of great interest as regards the search for oil. The logs are given of four of the recent wells. G. D. H.

871.* Activity in North Texas Area Approaching Record High. D. H. Stormont. *Oil Gas J.*, 28.3.40, **38** (46), 50–51.—Two new fields have recently been opened in Montague county, and interest also centres on Archer, Clay, and Cooke counties. Completions are now running 40% higher than a year ago. Some 67 wildcats are to be drilled, mainly to depths of 4000–5000 ft.

Near Bonita the discovery well yields oil from broken sand and granite wash in the Bend series at 5241–5249 ft. This well gave 254 brl. of oil in 3 hr. It was drilled on a seismic high, and failed to shown Strawn or Canyon production. The second discovery is near Ringgold. This also failed to find production in the Canyon or Strawn, but gave 240 brl. of oil in 3 hr. from an arkosic conglomerate in the Bend series at 5690–5704 ft.

Much leasing is taking place on the flanks of the Red River Uplift and where it merges with the Bend Arch. G. D. H.

872.* New Guinea. Anon. *Oil Gas J.*, 28.3.40, **38** (46), 72.—Two shallow wells are producing low-gravity oil from about 200 ft., and a showing of gas and several small showings of oil have been encountered in the two deep tests in the South Vogelkop. The wells are 4600–4950 ft. deep and not yet finished. G. D. H.

873.* Complete Flowing Well in Sparta–Wilcox Trend. F. L. Singleton. *Oil Gas J.*, 4.4.40, **38** (47), 23–24.—Production has been found in north-east Beauregard Pariah,

Louisiana, in the Wilcox at 8356–8373 ft. It follows the abandonment of a well in the same block which had Sparta–Wilcox showings.

In north-east Wharton county, on the Texas coast, gas and distillate have been logged in sand stringers at 9900–10,000 ft. Production tests are being made. Several wells had been drilled in this area, but were not taken down to the Wilcox.

Gas and oil showings have been found in a De Witt county well at depths of more than 7800 ft. Two blow-outs in the West Tuleta field and the old Bruni field are significant, and both had Sparta–Wilcox showings.

These recent wells add approximately 250 ml. to the prospective Wilcox trend. The area covers much virgin territory as well as numerous shallow Jackson shore-line fields. There is active leasing and much geophysical work in progress. G. D. H.

874.* Oklahoma City Field Enjoying another Periodic Flurry. D. Dalrymple. *Oil Gas J.*, 11.4.40, **38** (48), 14, 139.—Details are given of recent wells drilled in the Oklahoma City field. Many of them are encroaching on the city itself. Up to the beginning of 1940, 475,640,053 brl. of oil had been obtained, 343,894,914 brl. being from the Wilcox sand zone alone. There are twenty-two pay zones, including eight gas zones. Oil is found in the Wilcox sand, Lower and Upper Simpson, Pawhuska, Layton, Oswego detrital, Cleveland, Lower, Middle and Upper Hoover, Tonkawa, oolitic, and Prue formations. There are 13,253 productive acres. Tables are given of the distribution of the wells between the different zones, of the recoveries from these zones, and of production and other data for the various areas. G. D. H.

875.* Discovery of Small Geophysical Structure Arouses Mississippi. G. Weber. *Oil Gas J.*, 11.4.40, **38** (48), 25–26.—In east Yazoo county oil has been discovered 25 ml. north-east of Tinsley. A show was encountered in the Eutaw at 4871–4892 ft., and a little oil was recovered on testing. It demonstrates that small prospects, of which there are several hundred, are capable of production, in addition to the larger structures such as Tinsley and Jackson, which are evident from surface geology and subsurface information. Numerous wildcats are being drilled throughout Mississippi.

The Tinsley field has recently been extended in three directions. G. D. H.

876.* A.A.P.G. Growth Parallels Expansion of Petroleum Geology. J. E. Thomas. *Oil Gas J.*, 11.4.40, **38** (48), 30–33.—The parallel growth of the American Association of Petroleum Geologists with the greatest expansion in the oil industry and greatest improvement in exploratory technique is given. The growth of such important theories as the anticlinal theory and such vital subjects as geophysics is reviewed.

A. H. N.

877.* East Texas Looks Forward to Somewhat Dubious Future. G. Weber. *Oil Gas J.*, 18.4.40, **38** (49), 24, 25, 107.—The total oil production in 1939 was 146,969,889 brl. together with 60,000,000 brl. of salt water. At the end of the year the mean pressure was estimated at 1065 lb./in.^{2}. The pressure drop per 1,000,000 brl. of fluid extracted was 0·231 lb./in.^{2}, against 0·131 lb./in.^{2} in 1938. 381 wells were completed in 1939 and 269 wells were plugged. In November 1939 4405 producing wells were affected by water. 6300 wells are on the pump.

Most of the salt water is disposed of in evaporation pits, but some is returned to the Woodbine sand.

A number of tables give production details. G. D. H.

878.* Drilling Play Reflects Activity near Gulf Coast Salt Domes. Anon. *Oil Gas J.*, 25.4.40, **38** (50), 92, 95, 102.—New discoveries have been made on old salt domes. Such is the case at Anse La Butte and Bayou Blue. Of 104 known salt domes on the Gulf Coast, twenty-seven are not now producing, although eleven of these have done so. It is generally believed that all the domes will eventually be found to be productive. West Hackberry, known since 1902, did not yield oil until 1928, in spite of intermittent drilling, and important production was developed only in the last few years. Few domes have been completely explored.

Drilling is now proceeding on fifty-seven domes, including previously non-productive domes. G. D. H.

879.* Sparta–Wilcox Trend again in Limelight of Gulf Coast Activity. F. L. Singleton. *Oil Gas J.*, 25.4.40, **38** (50), 121, 123.—Production at Eola now covers 3000 acres, and is still undefined in the north-east and in the south-west. Since the discovery of Eola the only Wilcox production opened was at a depth of 10,000–10,250 ft. at Ville Platte. The succeeding period has had much wildcatting and many failures. However, one dry hole does not condemn an area, a fact which was demonstrated in Beauregard Parish, where oil has been found in the upper Wilcox at 8356–8373 ft.

In Montgomery and Wharton counties two wildcats are in process of testing. One has flowed oil and shown several hundred pounds of gas pressure.

Just west of Thomaston, in De Witt county, a large distillate producer has been completed in the top of the Wilcox at 7855–7883 ft. Late in 1939 high-pressure gas was found in the Sparta and Wilcox at Bruni and West Tuleta.

The upper limit of production from the Sparta–Wilcox series is generally considered to be 5000 ft., in view of the large amount of freshwater sands at the outcrop which has prevented the accumulation of oil at lesser depths.

The De Witt discovery has extended the line of Sparta–Wilcox fields over 160 ml. through virgin territory. G. D. H.

880.* Summary of Operations on Texas and Lousiana Gulf Coast. Anon. *Oil Gas J.*, 25.4.40, **38** (50), 185–186.—The names of the pools, year of discovery, number of producing wells in each pool, daily average production, accumulated production by pools, number of active operations, and production depths in each pool are tabulated. G. D. H.

881.* Fields Better than Tinsley Likely for Mississippi. J. H. Todd. *Oil Wkly*, 15.4.40, **97** (6), 17–26.—The Cockfield and Sparta have definite possibilities over a limited part of southern Mississippi, but the most promising horizon above the Cretaceous is the Wilcox. Heavy oil has been found in sands in the basal Wilcox on the flanks of the Jackson uplift. There have also been shows in several wells in the south of the State. The Ripley formation has sizeable sand bodies. The Eutaw is expected to be a major oil-producing horizon, and at Tinsley the Woodruff sand is at the Eutaw–Selma contact. There have been various evidences of petroleum in the Eutaw. The Tuscaloosa, the basal member of the Cretaceous, is largely non-marine gravels, sands, and shales, but has oil showings at various points. Its oil potentialities are considered good. In the central and southern part of the State the Comanche occurs, and has already proved a good producer. Hopes are entertained for the Jurassic, Permian, and older beds.

The Jackson uplift is of igneous origin, and raises the beds for 2500 ft. The crestal gas field is almost exhausted.

Parts of north-east Mississippi are affected by the Cincinnati arch. Igneous plugs occur in many parts, but so far oil has not been found over them. It is possible that the weaker magnetic anomalies will be better oil prospects. There are large anticlines and also salt domes. Deep-seated salt structures, of which type the Tinsley dome is believed to be, are being sought. Tinsley has 300–600 ft. of closure on the top of the Selma, and is a N.N.W.–S.S.E. anticline. There are several faults. The twenty-eight producers lie in a proved area of 2000–2500 acres. The Woodruff sand averages 20 ft. thick and has a maximum of 100 ft. The Stevens sand is 10 ft. thick, and the Hunt sand 15 ft.

There are possibilities of stratigraphic traps in Mississippi, for the Eutaw and Tuscaloosa both pinch out. G. D. H.

Geophysics.

882.* Some Practical Results of Micromagnetic Prospecting. W. P. Jenny. *Oil Gas J.*, 25.4.40, **38** (50), 132–134.—In Texas during 1939 1103 out of 1196 wildcats were failures.

Magnetic anomalies are more commonly due to the magnetic content of the sediments than to the basement. The method whereby sedimentary structures are determined has been called micromagnetics. At Eola the developed field agrees well with

the micromagnetic predictions. The experience at Eola and at other Sparta–Wilcox structures seems to show that the magnetic anomaly is the result of magnetic beds of Wilcox or Lower Eocene age.

At Anahuac micromagnetics indicated a fault which was proved later. Other examples of the use of micromagnetics are given. G. D. H.

883.* Geochemical Well Logging. E. E. Rosaire. *Oil Gas J.*, 25.4.40, **38** (50), 114, 119.—Geochemical anomalies are due to the slow effusion over geological time of hydrocarbons driven into and through the surrounding and overlying sediments by reservoir pressure. Anomalies of the same magnitude occur over a field 13,000 ft. deep as over one only 1500 ft. deep. Geochemical prospecting has been used at the surface with soil samples, but well cuttings also yield suitable data. By this means "dry" holes can be graded qualitatively as to closeness to an oil deposit. Zones can be recognized which have significant amounts of hydrocarbons and therefore require careful coring. Blowouts may be avoided. In effect the geochemical well log extends the vertical hole 500–1000 ft. downwards and $\frac{1}{4}$–$\frac{1}{2}$ ml. laterally. G. D. H.

Drilling.

884.* California Drilling Speed Record Broken. L. P. Stockman. *Oil Gas J.*, 11.4.40, **38** (48), 89.—The record for fast deep drilling is broken by drilling 13,157 ft. of hole and landing 12,878 ft. of 6$\frac{5}{8}$-in. casing in 60 days. The equipment used is described. A. H. N.

885.* Deep Cable-tool Drilling in Appalachian District. J. A. Fox. *Oil Gas J.*, 18.4.40, **38** (49), 62; and also in *Oil Wkly*, 22.4.40, **97** (7), 23.—*Paper presented before American Petroleum Institute.*—Two unsolved problems in connection with cable-tool drilling to depths exceeding 5000 ft. in the Appalachian district are particularly important at this time. The problem of improving drilling technique to achieve a longer working life for wire drilling-cables is considered of major importance because the cost of wire lines is one of the largest items of expense chargeable to deep wells. The second problem is to devise a means of overcoming the disastrous and expensive effects of the gas blowouts which are encountered in several parts of the Appalachian area through a zone beginning approximately 300–500 ft. above the top of the Onondaga line.

The author discusses the experiences of his own firm in these fields and presents the practical and admittedly empirical conclusions reached therefrom.

It is found that the life of the wire drilling-cables can be materially extended by drastically reducing the total weight of the tools and, at the same time, lengthening the drilling stroke. The weight of the tools is reduced by shortening the stem (or bar) below conventional lengths. Full details are given.

The blowouts are due to high-pressure gas pockets which occur in quantities just sufficient to throw up the tools and cavings some distance up the well, but not enough to eject them out of the well completely. Consequently the tools fall back and the cavings follow down, resulting in extremely difficult fishing jobs.

The use of salt water and a special technique evolved in the fields, and described in detail in the paper, is believed to have solved the problem, not so much as preventing these blowouts, but in rendering them comparatively harmless. A. H. N.

886.* Marine Drilling on Gulf Coast. N. Williams. *Oil Gas J.*, 25.4.40, **38** (50), 74.—A description is given of two of the largest and most completely outfitted marine rigs assembled on the Gulf Coast. Designed to meet the greater requirements and emergencies occasioned by deep drilling in water-located areas, these rigs are materially expediting development in this field, in which important production is being found in sands from 8000 to 9000 ft. deep.

Wells are now being drilled to 9000 ft. and completed in less than 3 weeks, including moving time. Unusual drilling conditions have been experienced so far, in that the formations are exceptionally soft, permitting the hole being made almost as rapidly as the drill stem can be lowered and cuttings removed. A. H. N.

887.* Ten Holes Drilled from One Marine Location. Anon. *Oil Gas J.*, 25.4.40, **38** (50), 105.—Directional drilling has resulted in successfully exploring and proving up an area nearly a mile square, from a single, centrally located drilling pier. In this project ten wells have been completed so far, in addition to nine others drilled into exploratory locations. This represents nineteen tests drilled from a single pier. The nine uncompleted wells were original holes, of some of the ten completed wells, which failed to get production at their respective subsurface locations and then were side-tracked at some point up the hole, and new holes drilled to other entirely separate location or different sands. By these means of side-tracking unproductive tests there have been no actual failures in the field, judged ultimately. The first test was drilled vertically.

For the most part the courses of the holes were governed by controlled drilling. Deflecting tools were run only for sharp changes in course. The usual practice was to drill vertically to 1200–1400 ft., where a 9⅝-in. casing was run. The deflecting tool was run to make the first deflection and establish the right direction in which a uniform sweeping drift would end the hole at the desired horizontal displacement and depth. Single-shot surveys were run regularly to check the course of the drift.

Data and a plat are reproduced, together with a description of the operations in attaining the final results. A. H. N.

888.* Record Keeping Reduces Costs, Increases Rotary Rig Efficiency. H. F. Simons. *Oil Gas J.*, 25.4.40, **38** (50), 124.—Drilling in the Gulf Coast is constantly tending towards deeper horizons than previously exploited. A method of predicting costs of proposed tests is described. It provides the oil company with a permanent record of all the essential facts and makes it possible to apply preventive measures instead of the more expensive remedial ones.

The system consists essentially of compiling in concise form all the pertinent data developed by drilling each test. Two charts are used, one showing mud conditions and mud treatment throughout the drilling of the well, and the other showing drilling and completion information.

The mud chart shows a driller's log of the well, mud weight, viscosity, percentage of solids, and sand content at the flow-line and at the pump suction, as well as a summary of treating materials used and, sometimes, pH values too.

The drilling chart gives footage made each day, driller's log of the well, bit record, core record, breakdown of drilling time, casing and tubing record, screen assembly and well size at various depths. Orientation points and amount of deflection is shown in directionally drilled wells. A. H. N.

889.* Standardized Layout Decreases Time Required to Assemble Rig. Anon. *Oil Gas J.*, 25.4.40, **38** (50), 131.—Handling of the mud in Gulf Coast drilling operations is a major difficulty, due to the rapidity with which deep holes are drilled, depths of 10,000 ft. are reached in approximately 30 days. Mud conditioning and handling have led to the development of some unusual mud systems and also to a standardization which increases the efficiency. These are discussed. A. H. N.

890.* Deep-drilling Practices. Anon. *Oil Gas J.*, 25.4.40, **38** (50), 150.—In this long paper a review is made of deep-drilling practices used in the Gulf Coast area. It is one of a series of papers published in this number of *Oil and Gas Journal* dealing with drilling, production, transportation, and refining activities in the Gulf Coast fields of the U.S.A. A. H. N.

891.* Deep Development Showing Increase. Anon. *Oil Gas J.*, 25.4.40, **38** (50), 170.—According to a recent compilation, 349 wells, including active operations in first week of April, have been drilled to 10,000 ft. on the Gulf Coast. Tables and data are presented giving number of wells drilled and producing below 10,000 and 11,000 ft., by years and localities. A. H. N.

892.* Electrical Well Logging and Core Analysis. P. B. Leavenworth. *Oil Gas J.*, 25.4.40, **38** (50), 197.—*Paper presented before American Petroleum Institute.*—The

author compares the utility and characteristic advantages of electrical well logging with those of core analysis, and concludes that :—

For regional correlation the electrical log is probably sufficient.

For field correlation use electrical log for the determination of structure; use both methods for details of the producing section.

For well completion both are of value, as great detail is often necessary to successful completion, particularly in thin sand fields and where gas and water problems are important.

For estimates of oil and gas both are of value, as the same problems exist as in well completions.

For well spacing both are of value, as core analysis may indicate rate of efficient withdrawals and electrical logs the structure and thickness of pay members.

A. H. N.

893.* Pioneering the Rotary in California. L. B. Little. *Petrol World*, April 1940, **37** (4), 23–26.—The paper is an interesting historical sketch of the early development of rotary drilling practices, written in a light vein. A. H. N.

894.* Application of Chemicals to Drilling and Producing Operations. W. W. Robinson. *Petrol. World*, April 1940, **37** (4), 32.—Without elaborating upon the details of any one type of development, this paper considers broadly the steadily growing trend in the application of chemicals to problems affecting the drilling for, and production of oil. Chemicals for the treatment of muds, the control of heaving shales, treatments for lost circulation, special cements, the use of acid, selective water shut-offs, and the application of surface-tension reducing agents are reviewed.

The growth in importance of chemical technology, which has already been of material assistance to the driller and producer, is emphasized. A list of 86 references is presented. A. H. N.

895.* Drilling-rig Layout for Water Locations in the Gulf Coast. I. W. Alcorn. *Petrol. Engr*, April 1940, **11** (7), 77–80.—The total cost of an average setup for either a steam or diesel rig containing a drilling barge, power or boiler barge, mounting equipment, piping, etc., is about $85,000. Straight piling structures supporting the entire rig would cost from $10,000 to $20,000. A programme involving eight or ten wells would about amortize the barge investment.

As opposed to these two solutions, it is suggested that an economical solution to the problem is a compromise of the two methods. The method which is now in use involves mounting on a piling foundation the derrick, draw-works, engine, rotary table, and shale shakers, whilst a barge is used to carry the boilers, pumps, boiler-feed unit and generators, suction mud tank, settling-tank and fuel-oil tank as well as a pipe-rack and a small 10-ton derrick mast with a 35-ft. boom.

An engineering and economic study of the piling problem resulted in the elimination of twenty-five piles by using steel structural members, the cost being further reduced because the steel was used on more than one location. The design was for 150,000 lb. rotary load plus 100% impact, or total of 300,000 lb. and assuming that the four piles under the rotary table were out of the picture, as it is possible for them to be, due to washout of the hole. Drawings are reproduced showing the chief components and their dispositions in the design.

After placing the barge in operation it was noted that only a very slight movement, relative to the pilings, was perceptible even during fairly rough weather. This led to considerations of the relationship of mass, depth of water, submergence of barge, and its length as affecting the stability, and it is believed that the entire setup lends itself particularly well to much deeper water, and possibly to tideland operations in some instances.

Costing of the combination of piling and barge system compares favourably with either of the two methods used separately. A. H. N.

896.* Deepening and Completing a Well in the Lisbon Field, Louisiana—a Study in Modern Co-operative Practice. Pt. 3. P. D. Torrey and F. H. Miller. *Petrol. Engr*, April 1940, **11** (7), 118.—This paper forms the third part of an exhaustive article

detailing every operation undertaken in drilling and deepening a certain well. In this part a discussion is given of the methods used to prevent blowouts, and of the precautions, tests, and analysis of mud performed in drilling through potentially dangerous strata.

A fluoroscope is described, which is adapted to test muds for oil contents. Mercury vapour lamps are used to emit invisible rays which impinge on the oil and after being absorbed and their wave-length changed are emitted as visible light waves. Crude oil in minute quantities can be detected as well as differentiated from refined oil, as the two emit different wave-lengths, and hence are of different colours.

Similarly gas detectors are described and their operations detailed. The use of the audible signal is a qualitative test of the presence of gas in the mud; the number of points required to turn the dial of the "preselector" to silence the horn is a rough quantitative measure of the gas—the larger the quantity of gas the greater the number of points required.

Electrical logging and time logging are next discussed with the same detail regarding the well. The study of the rate of penetration and bit performance concludes Part 3 of this paper. Further parts are to be published in forthcoming issues of the *Petroleum Engineer*. A. H. N.

897.* Rotary Super-rig of Advanced Design is Largest in Operation. W. A. Sawdon. *Petrol. Engr*, April 1940, **11** (7), 153–155; cf. also *Petrol. World*, April 1940, **37** (4), 27.—The paper describes, with photographic illustrations, what is believed to be the largest well-drilling plant ever assembled, which is anticipated to meet the heaviest duty demands likely to be encountered in deep drilling for some time to come. It is steam driven and has the largest draw-works yet built and a combination standby draw-works and rotary table driven by one engine.

Detailed dimensions and capacities for the chief components are given. To present the potentiality of the rig the following illustrates its performance. One week after a well was spudded-in, a depth of approximately 6700 ft. had been reached with 12¾-in. surface string run and cemented. The well will probably be drilled to a depth of about 11,500 ft. Completion, including running and cementing 7⅝-in. casing, and running 5¼-in. liner and 2½-in. tubing, is expected in less than 40 days. A. H. N.

898.* Steam Saving Set-up Used on Dominican Concession. E. S. Post. *Oil Wkly*, 15.4.40, **97** (6), 15–16.—A steam saving set-up used in the Dominican Republic has not only provided a material saving in drilling costs, but has also further increased the operating efficiency. The equipment is designed to drill wells not exceeding 6000 ft. in depth.

The chief revision in the equipment was in the pump power. Instead of using two conventional-type 14½ in. × 7½ in. × 18 in. pumps, only one was included in the arrangement. A special 7¼ in. × 18 in. power slush-pump was connected to a horizontal twin 7 in. × 7 in. steam engine by the use of a V-belt. The conventional type of pump is used as an auxiliary unit, whilst the specially designed power unit is employed in the regular drilling.

This hook-up has reduced the steam demand of the entire rig by approximately 40%. In terms of fuel oil, the demand was lessened from 130 brl./day to approximately 70 brl./day. Two boilers were found sufficient for the operations instead of three; this fact considerably reduced transportation and equipment costs. A. H. N.

899.* Methods of Recovering Stuck Drill Pipe. Pt. 2. J. E. Warren. *Oil Wkly*, 15.4.40, **97** (6), 27 (cf. Abstract No. 752).—*Paper presented before American Petroleum Institute.*—In Part 1 the various factors that may cause drill-pipe to stick in the well-bore were considered in detail. In this Part a number of methods of recovering the pipe are studied in the event of the precautions previously outlined having been overlooked or an accident having occurred.

Recovery methods are outlined both for releasing the pipe intact and in sections. These methods include bumping the pipe, the use of clear water or mud colloids in circulation, gas slugging, the use of hydrochloric acid, backing-off pipe, the use of

inside cutters, the use of left-hand drill pipe, recovery by shooting, washing-over pipe, the use of outside cutters and various other methods adapted for specific cases. Details of most of these methods are presented in a simple and straightforward manner. A. H. N.

900.* Heaviest Drilling Rig Points Way to Lower Drilling Costs. Anon. *Oil Wkly*, 22.4.40, **97** (7), 18–22.—The largest equipment ever assembled is installed on a drilling rig in the Rio Bravo field, California, which is expected to be drilled to 11,500 ft. The trend towards over-size equipment for rapid drilling of deep wells in California has already resulted in cutting down drilling time for depths below 11,000 ft. from several months to current averages ranging from 36 to 45 days, spudding until the oil is turned into tanks.

Whilst a drilling layout as described in the paper represents a heavy capital investment, probably approaching $500,000, such equipment is pointing the way to substantial savings in drilling costs. In the early development of this field wells cost in the neighbourhood of $180,000 each to complete. With heavier equipment wells are now drilled at an approximate cost of $100,000. The new equipment being used is believed to involve still lower drilling costs. Thus, with numerous locations to drill a large investment in improved equipment is sound business.

It is estimated that with 4-in. drill pipe the equipment could reach depths ranging from 15,500 to 16,000 ft., and that if 3-in. drill pipe of sufficient strength could be developed it would be capable of going considerably deeper.

Although the equipment was not designed with the view of establishing new drilling records, but for lowering drilling costs in deep fields, a new California record for fast drilling—1385 ft. in one 8-hour shift—was established. A well of 11,223 ft. took 27 days from spudding until the time it was ready for electric logging.

Photographic illustrations of the various components are given, together with explanatory notes regarding dimensions and capacities. A. H. N.

901.* Spudder Use Increasing with New Applications. Anon. *Oil Wkly*, 29.4.40, **97** (8), 45–50.—This is the first of a series of composite reviews which it is proposed to present from time to time covering new developments and important features in design, construction, application, operation, and maintenance of various types of oil-field and pipe-line equipment. The articles are illustrated with specific examples taken from manufacturers' current offerings. A. H. N.

902.* New Magnetic Method for Orienting Deflecting Tools. Anon. *Petrol. Times*, 18.5.40, **43** (1114), 460.—A description is given of a new method of accurately orienting deflecting tools at the bottom of bore-holes which is extremely accurate, requires less time than methods hitherto known, and which provides a positive photographic check of the actual position of the deflecting tool.

The orientation is accomplished by the use of a non-magnetic sub, containing two small magnets and provision for seating a directional magnetic single-shot instrument. The brief description of the instrument and its operation is illustrated by a sectional drawing of the non-magnetic sub and of a sample record.

This method has been successfully used in the field for more than a year. Correct bottom-hole orientation of the deflecting tool to within ½° in azimuth can be obtained. A. H. N.

903. Drilling Patents. W. G. Milne. U.S.P. 2,196,320, 9.4.40. Appl. 7.12.38. Dead end cable clamp.

E. G. Simmons. U.S.P. 2,196,366, 9.4.40. Appl. 26.7.39. Tool puller comprising a grip adapted to grip the drill rod.

J. Kahn, W. F. Schulz, and C. Schofield. U.S.P. 2,196,454, 9.4.40. Appl. 10.12.38. Pipe-thread protector.

R. K. Hertel. U.S.P. 2,196,460, 9.4.40. Appl. 13.4.36. Safety hook with shank supported on compression spring and anti-friction bearing.

R. F. Bolton. U.S.P. 2,196,517, 9.4.40. Appl. 28.10.37. Winged whipstock for deflecting drill bits.

J. D. Hughes. U.S.P. 2,196,528, 9.4.40. Appl. 28.10.37. Knuckle anchor for whipstocks.

F. J. Spang. U.S.P. 2,196,538, 9.4.40. Appl. 8.3.38. Apparatus for cementing wells.

B. F. Shepherd and R. D. Zimmerman. U.S.P. 2,196,598, 9.4.40. Appl. 30.9.37. Rock drill-bit.

R. C. Baker. U.S.P. 2,196,652, 9.4.40. Appl. 10.10.36. Apparatus for cementing well-bores with circulation ports which are opened progressively in an upward direction.

R. C. Baker and C. E. Burt. U.S.P. 2,196,653, 9.4.40. Appl. 5.5.39. Cementing, washing, and acidizing retainer for perforated well casings.

C. E. Burt. U.S.P. 2,196,656, 9.4.40. Appl. 12.12.38. Well-cementing apparatus.

C. E. Burt. U.S.P. 2,196,657, 9.4.40. Appl. 21.4.39. Well-cementing apparatus.

C. E. Burt. U.S.P. 2,196,658, 9.4.40. Appl. 5.5.39. Cementing, washing, and acidizing retainer for oil wells.

J. H. Grubb. U.S.P. 2,196,661, 9.4.40. Appl. 14.1.39. Circulating well-packer.

W. C. Markle. U.S.P. 2,196,704, 9.4.40. Appl. 3.11.38. Windbreak for oil derricks.

L. A. Parnell. U.S.P. 2,196,938, 9.4.40. Appl. 24.10.39. Dead end clamp for cables.

E. L. Potts. U.S.P. 2,196,940, 9.4.40. Appl. 25.7.38. Deflecting bit.

F. W. Sharp. U.S.P. 2,196,944, 9.4.40. Appl. 21.8.37. Deflecting bit.

O. Hammer. U.S.P. 2,196,966, 9.4.40. Appl. 24.10.39. Well-pipe joint embracing a tapered pin and box with mutually engageable threads, and shoulders capable of transmitting compression stresses.

D. B. Monroe. U.S.P. 2,197,019, 16.4.40. Appl. 23.12.38. Drill-guide for rotary rigs.

C. H. Sweet and L. S. Chambers. U.S.P. 2,197,062, 16.4.40. Appl. 11.6.37. Orienting core-barrel by attaching a surveying instrument to the top of core-barrel.

W. A. Norman and T. M. Norman. U.S.P. 2,197,222, 16.4.40. Appl. 27.1.37. Plug for wells and the like.

T. C. Strength. U.S.P. 2,197,227, 16.4.40. Appl. 17.10.38. Directional well-drilling tool with surveying tool adapted to be run through the pipe to record the position of the deflecting means.

P. C. Matlock. U.S.P. 2,197,344, 16.4.40. Appl. 25.2.39. Setting tool.

D. G. Hawthorn. U.S.P. 2,197,392, 16.4.40. Appl. 13.11.39. Drill-stem section containing an electrical conductor attached to and insulated from the inside of the pipe.

F. Maines. U.S.P. 2,197,396, 16.4.40. Appl. 29.12.37. Oil-well cementing plug, provided with passage for mud fluid and cement, the passage-way being closed by a membrane which ruptures upon exerting a predetermined pressure.

H. C. Block and L. A. Layne. U.S.P. 2,197,403, 16.4.40. Appl. 25.9.37. Bottom connection-screw through setting-tool.

A. S. Volpin. U.S.P. 2,197,455, 16.4.40. Appl. 28.6.37. Slush pump-valve.

W. G. L. Smith. U.S.P. 2,197,531, 16.4.40. Appl. 12.1.38. Drill-pipe protector.

T. H. Stancliff. U.S.P. 2,197,541, 16.4.40. Appl. 20.3.39. Drill-bit of roller type.

J. W. Millington and W. T. Evans. U.S.P. 2,197,571, 16.4.40. Appl. 3.10.38. Bore-hole exploring apparatus containing a motor which moves proportionately to the motion of an electric cable lowered into a well.

G. Jensen and G. Jensen. U.S.P. 2,197,580, 16.4.40. Appl. 25.4.38. Cable-lift well-auger.

L. S. Dewees. U.S.P. 2,197,790, 23.4.40. Appl. 13.8.38. Drill-stem orienting device which allows free axial translational motion of drill-stem, but which gives a direct reading of rotational component of the motion of stem.

C. C. Brown. U.S.P. 2,197,920, 23.4.40. Appl. 5.4.38. Cementing apparatus, a retainer for cased wells.

J. C. Wright and M. H. Wright. U.S.P. 2,197,991, 23.4.40. Appl. 10.10.36. Tool for straightening well-bores utilizing a body of higher specific gravity than ferrous materials and a flexible joint so that gravity will tend to pull the bit vertically.

J. C. Rogers and J. D. Hall. U.S.P. 2,198,016, 23.4.40. Appl. 18.8.38. Lateral drilling mechanism using a rotary flexible drilling stem and a deflection member for horizontal drilling in a vertical well.

J. E. Hoffoss. U.S.P. 2,198,083, 23.4.40. Appl. 3.6.38. Core taking apparatus.

R. L. Smythe. U.S.P. 2,198,093, 23.4.40. Appl. 28.4.37. Dead-end cable-clamp.

W. B. Lerch, C. H. Mathis, and E. J. Gatchell. U.S.P. 2,198,120. Appl. 19.5.38. Method of sealing or fixing casing tubes in wells using 50 parts sodium silicate, 50 parts water and 100 parts of hydrochloric acid and carbon black.

W. Tarkington. U.S.P. 2,198,490, 23.4.40. Appl. 20.3.39. Oil-well bailer of the pressure type. A. H. N.

Production.

904.* Acidizing Illinois Limestones Presents Many Problems. W. W. Love. *Oil Gas J.*, 11.4.40, **38** (48), 74.—Acidizing operations have been of continuously increasing importance in Illinois since the discovery of the Clay City Pool in 1937. The structure and characteristics of the producing horizons are described, followed by present acidizing practices. The development of Illinois acidizing is sketched.

In one instance, acidizing by a two-stage process, injecting 1000 gal. in the first stage and 3000 gal. in the second, produced no sustained increase in production. It is found that a single-stage process using 5000 gal. is the best method of treating the pay.

In numerous cases wells have required clean-out or re-acidizing due to the presence of oolites, closely cemented by calcium carbonate.

Approximately 87% of all acid used in the Illinois basin contained an additive agent to prevent the formation of emulsions between the spent acid and crude oil. Simple experiments are described to determine which of any number of acids will be best suited to acidize a formation carrying a certain crude oil.

Sustained-action acid is used where the limestone is too easily attacked by the acid. Neither increasing the quantity of acid nor the rate of injection is found to render the acid effective along a wide radius from the well when the limestone is highly soluble in acid.

Jelly seal has been used extensively in acidizing wells having thick producing sections with varying porosities and separate producing zones. When long saturated sections are treated, the tighter of the two is always treated first. Methods of setting

jelly seals are described for various positions of the more permeable section compared with the less permeable one.

The use of mechanical treating devices—*e.g.* packers, jet guns—is discussed and illustrated. A. H. N.

905.* Illinois Uses Several Explosives and Tamping Methods. H. F. Simons. *Oil Gas J.*, 11.4.40, **38** (48), 81.—There is no standard method of shooting in the Illinois fields. Each company uses procedures which are suited to the problems presented in the areas where operations are conducted.

Shooting too close to the casing-shoe frequently results in wrinkling, splitting, or buckling of the casing. One company seldom gets within 15–20 ft. of the casing-shoe, although in one case shooting is reported to have been successfully done within 3 ft. of the shoe.

The general practice is to use solid tamping, either the special quick-setting gypsum cement, sand, or gravel, or a combination of these three.

When fluid tamping is used, the well must be kept constantly full of oil. No water is used, as it may cause water-logging after the shot is discharged. If the well is not full, the concentration of the vibrations at the fluid level may result in splitting the casing. Similarly an oil/water interface may have the same consequences.

Practical hints and procedures are detailed. A. H. N.

906.* Metals in Production—Balls, Seats and Polished Rods. W. L. Nelson. *Oil Gas J.*, 11.4.40, **38** (48), 92.—Recommendations are given for use as a guide in specifications for metals used in balls, seats, and polished rods. These are taken from recognized manufacturers of equipment and metallic materials. Percentage composition in terms of carbon, manganese, nickel, chromium, molybdenum and others, yield-points, elongation, and Brinell hardness, as well as notes on heat treatment, are presented for metals to be used in balls and seats and in polished rods. Seven references to literature on metals for these parts are appended. A. H. N.

907.* Ohio's First Water-flood Project Promises Moderate Success. J. P. O'Donnel. *Oil Gas J.*, 18.4.40, **38** (49), 42–43.—After more than nine months' operation, an evaluation of the first water-flood in Ohio indicates that this process is adaptable to the new locality, although the practice as developed in Pennsylvania will have to be changed to meet the new conditions.

The chief conclusions reached are that while development costs are lower than at Bradford, because of shallower drilling and lower pressures, this factor is offset by the much lower price of the crude oil. Extremely wide and unpredictable variations in sand thicknesses and the total absence of sand in some places indicate that development should be undertaken progressively. A. H. N.

908.* Electrification of Pumping Equipment in Illinois. R. E. Hammond. *Oil Gas J.*, 18.4.40, **38** (49), 44–46.—*Paper presented before American Petroleum Institute.*—The operator who has elected to use electric power for oil-well pumping should consider a variety of factors in selecting his electrical equipment and planning its installation. A few of the most important of these are as follows: (1) advantages of "high slip" induction motors; (2) possibilities of time-switch control; (3) location of field substations to permit "looping" and under-building of secondary lines; (4) decreased well-service investment when pumping unit is set on side of well towards power line; (5) danger of over-building generating plants, and possibility of savings by use of purchased power for excess requirements during temporary peak-load period.

After the electric system has been built and placed in operation, attention should be given to the following considerations: (1) power system stabilization through load control and intermittent pumping; (2) possible advantages of power-factor correction; (3) increased power requirements during cold winter months.

A. H. N.

909.* Experimental Gas Lift at Sulphur Effective in Recovering Oil. Anon. *Oil Gas J.*, 25.4.40, **38** (50), 76.—Production records are reproduced and discussed, together

with the equipment used for gas-lifting operations in Sulphur Mines fields, Louisiana. A study of these records and of cost estimates shows that the operations were successful in effecting additional economical recovery of oil from wells in which the limit of commercial productivity by other means was believed to have been reached.
A. H. N.

910.* Formation Pressure Increased by Gas Injection. Anon. *Oil Gas J.*, 25.4.40, **38** (50), 98.—During the 14-month period from January 1938 to March 1939, while one well in a 7900-ft.-deep gas-sand was blowing wild after a blowout and cratering, all other wells in the sand were opened wide to relieve pressure on the sand, in order to minimize the hazard of charging of sands and spread of blowouts and craters. An estimated production of from 70 to 80 billion cu. ft. of gas was taken from the sand. These excessive withdrawals have reduced pressures to such an extent that fluids precipitated in the sand as a result of retrograde condensation.

By injecting gas at higher pressures it is believed that pressure in the sand will rise to a point where retrograde condensation is prevented and all the fluid be eventually made recoverable. Experiments have shown that as the pressure in the sand is building up, the gasoline content of the gas is rising.

Each well constitutes a separate recycling unit. The gas, stripped of its fluid content, is directly returned to the formation through the same well from which it has been produced. Equipment and procedure are described. A. H. N.

911.* Rapid Expansion in Recycling and Pressure Maintenance. Anon. *Oil Gas J.*, 25.4.40, **38** (50), 165.—A review is given of recycling and pressure-maintenance operations at present working and of those under way in the Gulf Coast area in this, the " Gulf Coast Number " of the *Oil and Gas Journal*. The paper is extensive.
A. H. N.

912.* Evaluation of Leases Subjected to Proration and Drainage. I. I. Gardescu. *Oil Wkly*, 22.4.40, **97** (7), 30.—If an oil-field is subjected to proration and active water drive, such as the East Texas or Hastings field, it is generally assumed that the producing life expectancy and the ultimate recovery of wells drilled up-structure will be greater than the average for the field. The paper attempts to find quantitatively how much greater these characteristics are.

To ascertain, for instance, how much oil a 40-acre lease located in the Hastings field will actually produce when all the geological and production facts are known, two actual cases are discussed in detail. The first case is located in the East Texas field, and the second in the Hastings field. The actual production behaviours of two wells are discussed as a preliminary.

The vital and secondary considerations to be made in solving such an essentially practical problem are given in detail. Economic and financial factors are taken into account in estimating the worth of the leases. A. H. N.

913.* Mathematical Analysis Applied to Specific Selection of Well Service Equipment. W. G. Wilson. *Oil Wkly*, 22.4.40, **97** (7), 44–46.—Mathematical formulæ are derived to solve the general problem of selecting the most suitable pumping equipment for a certain lease which is subject to recurrent floods of varying duration and intensity. Probabilities are assumed to find the probable production loss resulting from inabilities to service the wells during flood periods, and then to compare this loss with the cost of preventing it. Actual conditions over specific intervals may never correspond to the expectancy as calculated by assuming probability laws, but over a period of years the average correlation should be reasonably close.

To illustrate the significance and use of the formulæ and chart thus developed, the following specific problem is solved completely.

The present-day production of 50 brl. of oil/well/day is assumed, together with the facts that no water production exists and that sucker-rod equipment requires service every 45 days on similar leases in the field, and that like service requirements may be expected on the lease in question. Analysis of flood records for the stream adjacent to the lease indicates that over a period of many years there was an average of four floods every three years and that the average duration was 20 days.

The probable loss in production per well per annum is calculated. A convenient comparison of the merits of possible types of pumping equipment may be secured by determining the annual cost for each. This should include normal operation and maintenance expense, production losses, depreciation, and interest on unamortized investment, which may be averaged as interest on one-half the total investment.

A. H. N.

914.* Injection Method for Salt Water Disposal. Pt. I. B. Mills. *Oil Wkly*, 29.4.40, **97** (8), 15.—The East Texas field is the site of research programmes with the injection method of brine disposal. The field appears to possess all the requirements for adoption of the method and several conditions which limit the use of other systems. The paper presents, in three parts, a complete discussion of the procedure and methods employed by East Texas injection systems.

Both an experimental well, drilled in 1936, and more recent injection efforts in and near the field have proved the feasibility of returning the salt water to the producing formation in the Woodbine sand. Sufficient work has been done, however, to indicate that certain objectionable constituents must be removed from the water before returning it to the formation, a practice which adds materially to injection costs. On the other hand, injection of salt water is considered as a form of pressure maintenance by recycling.

The cost of converting an old oil-well into an injection well is much less than that of drilling a new well. This statement is discussed in detail.

Several wells take water by gravity or natural hydrostatic head, but in others it is necessary to pump the water into the formation. The use of pumps adds appreciably to injection costs, but in many wells pressures are nominal. An average analysis of several samples of Woodbine water is given and shows total solids amounting to 64,494 parts/million. Static head in injection wells is 1000–1100 ft. from the surface; the hydrostatic head at the sand is therefore about 500 lb./sq. in.

Treating plants are described to reduce the concentration of injurious constituent salts in the brine. Calcium carbonate is reduced from 114 parts to 5 parts/million in normal cases using one type of these plants. Diagrams, photographs, and a discussion detail the Tide Water plant for treating water before injection. Similarly, the Magnolia treating system is detailed. The first plant is a sludge-blanket type, and consists mainly of concrete skimming pit, centrifugal pump, treater tank, filter, and a control or clear-water tank. In the second type a more decided use of chemicals than has been practised by many operators is reflected.

A. H. N.

915.* New Multi-sand Completion Departures Introduced at Loudon. A. J. Sullivan. *Oil Wkly*, 29.4.40, **97** (8), 29.—Newly developed completion practices, in so far as they affect producing wells, are of two classes: those where a removable alloy is used in the production string, and those where the steel production string itself is partly removed.

In the first class are drillable casings made of an alloy consisting of 1% silicon, 1% magnesium, 0·3% chromium, with tolerances of − 0·2%, + 0·2%, and ± 0·05%, respectively, the balance being aluminium. Physical characteristics are quoted to indicate the strength of the alloy. Procedure in well completion using drillable casing and gravel packing is given.

A second type of removable casing is an acid-soluble casing made of an alloy of 3·3–4·7% aluminium, 0·2% minimum of manganese, 0·3% maximum of zinc, 0·5% maximum silicon, with the balance made of magnesium, save for 0·08% other impurities such as nickel and copper. The strength and other physical characteristics of the alloy are given, together with the practice of setting and removing such casing.

The second type of completion practice, where the steel production string itself is partly removed, is similarly detailed. The first use of shooting gave discouraging results, and rotary tools have now been evolved capable of milling steel casing economically. A window is milled in the casing, the hole is plugged back or bridged, loaded, and tamped down with 50 ft. of gypsum cement, topped out with water, and shot. The method promises to be a success.

Input well practices are also described. Aiming at maximum efficiency for the input wells drilled in these zones, a system of manifolding both surface and sub-

surface well equipment has been designed to achieve simultaneous control of gas to three sands through a common well. Detailed drawings and descriptions of the system are given. Both surface and subsurface equipment are reproduced.

A. H. N.

916.* Classified Code for Well Troubles. R. L. Bradley. *Oil Wkly*, 29.4.40, **97** (8), 60–61.—The paper deals with the production side of well troubles, and not with all well troubles. The major subdivisions are: (1) surface and (2) subsurface troubles or causes of troubles. Two tables further subdivide these items as follows:—

1. Well trouble causes on surface equipment: A, engines; B, clutch; C, countershaft; D, belt or chain, etc., till M, miscellaneous. These items are further subdivided—*e.g.* AA-1, air starting unit; AB-1, battery, etc.

2. Well trouble causes on subsurface equipment: N, oil-well pumps; O, sucker rods, etc.—to U, air-, or gas-lift. Flowing and swabbing wells are also listed. These items are further subdivided—*e.g.* N-1, rod coupling; N-2, adaptor rod, etc.

The code may be used not only as a quick reference to past work, but also as a reference to logically needed repairs or replacements in the future. Examples illustrate the use of the code index.

A. H. N.

917.* Microfilming Facilitates Petroleum Engineering Field Studies. C. V. Sidwell. *Petrol. Engr*, April 1940, **11** (7), 73–76.—An account is given of the practice of using reduced facsimiles of original oil company records preserved on film and filed in small space, thus rendering all field and office data easily accessible for reference and study. The usual film used in the motion-picture industry has a nitrate base and is very inflammable. When stored in closed space this type of film may lead to the formation of explosive fumes. The records, however, are taken on an acetate-base film which is no more inflammable than, and which is found to be as durable as, rag paper, and is entirely free from explosive fumes hazards.

The preservation of original oil-field records greatly facilitates petroleum engineering field studies, particularly as current records can be filed and made much more accessible than by the more conventional methods. The preservation of obsolete records not only results in a great saving of space and economical saving, but also insures against loss of valuable records. Portable equipment has been designed and developed that makes it possible to take the equipment to the work for the purpose of obtaining necessary data on any problem, in contradistinction with the present method of the application of photography by photostating, which can be used only when the work can be taken to the equipment, and which involves a cost that is prohibitive when copying is voluminous.

A. H. N.

918.* Analysis of Delayed Drilling Programme in Water-flooding Project. P. M. Phillippi. *Petrol. Engr*, April 1940, **11** (7), 103.—The usual or "no-delay" drilling programme in water-flooding areas is to drill the oil-well first and follow up at a later date with the water-wells. The initial production is small, but it gradually increases to a maximum, and the peak in oil production is reached. Wherever the characteristics of the sand vary over a wide range a great amount of bypassing occurs, with resultant shortening of the economic life of the field.

To overcome these difficulties the "delayed drilling" is used where the water-wells are drilled first and water under constant pressure is forced into the sand. The water first penetrates the looser streaks, and then, having no outlet, the tighter portions of the sand. After 6–18 months the oil-well is drilled in the centre (a five-spot system being followed) and peak production is at once encountered. A careful study of the permeabilities of the sand and balanced flooding operations are essential to the successful realization of the project. On a small lease it is possible to operate delayed drilling in the recommended manner, but it is not possible to maintain an absolutely balanced flood on a large property that is constantly undergoing development. Only a portion of the property can be developed at a time, and the water from the edge wells is certain to get beyond control.

Data covering an 8-year operating period on a Bradford oil-lease are presented to show the merits of the various plans of exploitation. These plans are: (1) no delay,

(2) balanced delay, (3) unbalanced delay, (4) two sides balanced, (5) three corner delay, and (6) one side only delay.

Balanced delay drilling in a heterogeneous body of sand in conjunction with selective shooting, where tight formations receive proportionately large quantities of nitroglycerine as compared with permeable formations, represents the best known method of operating efficiently.

When the sand exhibits uniform permeability no advantage is gained by delay drilling over the normal no delay programme. A. H. N.

919.* Improved Acidizing Mixtures Speed Separation of Spent Acid and Oil. C. E. Clason. *Petrol. Engr*, April 1940, **11** (7), 166.—Spent acid remains in solution with oil from a well, in varying quantities, for more than ten weeks following acidizing. Salt content of the oil increases for a long period after treatment. Lately it has been discovered that certain types of crude oil react with the acid, forming a stable emulsion which never breaks in some cases, and in others will break in comparatively short periods.

When acid is treated with substances which change the interfacial tension between the acid and the oil, thus permitting faster penetration through both large and small channels, the spent acid possesses the same characteristics. Hence acid thus treated will shorten the time during which the oil is subjected to contact with the acid. This fact will in turn reduce the deleterious effects produced in the refineries due to the presence of the spent acid in the oil.

The use of emulsion preventers is advocated, therefore, not only from the point of view of production of oil, but also from an easy and economic refining viewpoint.
A. H. N.

920. Annual Report of the Petroleum and Natural-Gas Division. Fiscal Year 1939. Anon. *U.S. Bur. Mines, Rep. Invest.* 3501, March 1940.—Once a year the Petroleum and Natural Gas Division of the Bureau of Mines takes stock of its various activities and gives an account of progress made in its endeavour to develop and carry out a co-ordinated system of research projects pertaining to oil and gas. The present report is divided into four main sections, as follows: Oil and Gas Production and Related Transportation; Chemistry and Refining; Special Chemical and Engineering Problems; and Helium.

In the production section emphasis is laid on the need for instruments to measure and record accurately subsurface pressures and temperatures; the development of standard methods of obtaining and analysing subsurface samples of crude oil; the physico-chemical properties of natural hydrocarbon mixtures; water as a source of energy in reservoirs and its use in propelling oil to wells; the use of a pressure core-barrel for bringing samples intact to the surface for analysis. Studies of factors affecting the flow of fluids through porous mediums, compaction of reservoir sands and rocks as oil and gas are withdrawn, spacing of wells with particular reference to Cutler's rule, and the control of gas–oil ratios as a means of bringing about gas conservation and efficient production of oil, also appear in this section.

The second section reflects the Bureau's desire for more efficient utilization of petroleum based on greater knowledge of its constitution. Problems concerned with distillation, hydrogenation, and refining each contribute their quota towards this desideratum.

Among the special chemical and engineering problems to which the Bureau has given attention are the disposal of oil-field brines, particularly in agricultural areas; the regular cleaning out of wells as a necessity for efficient production; the removal of salt from crude oil; and lastly the ever-searching question of prevention of accidents in the various phases of the industry.

The final section of the report covers the Bureau's activities in connection with the Government's plant at Amarillo, Texas, for the extraction of helium from natural gases. Brief accounts are given of the process, working conditions, and also of reserves of helium-bearing natural gases. In approximately ten years of operation ending 30th June, 1939, about 91¼ million cub. ft. of helium were extracted in the Amarillo plant, and even then the plant was operated at only about one quarter of its capacity. H. B. M.

921. Production Patents. C. K. Holt. U.S.P. 2,196,439, 9.4.40. Appl. 20.6.39. Well-cleaner for washing the perforations in the oil string or liner.

A. G. Horvath. U.S.P. 2,196,453, 9.4.40. Appl. 22.12.37. Jet pump adapted to work at the bottom of deep wells.

A. Hollander. U.S.P. 2,196,462, 9.4.40. Appl. 12.9.38. Semi-submersible motor pump.

H. C. Otis. U.S.P. 2,196,535, 9.4.40. Appl. 27.9.37. A well flowing-control device setting a maximum value on the velocity of flow of the well fluid.

R. J. Bean. U.S.P. 2,196,622, 9.4.40. Appl. 27.6.38. Detachable pipe-coupling.

J. L. Kofahl. U.S.P. 2,196,664, 9.4.40. Appl. 22.9.39. Control valve.

T. M. Ragan. U.S.P. 2,196,668, 9.4.40. Appl. 21.4.39. Packing for well devices.

W. E. Saxe. U.S.P. 2,196,816, 9.4.40. Appl. 6.9.38. Method and apparatus for automatically counterbalancing pumping apparatus on oil-wells.

J. H. Kidder. U.S.P. 2,196,993, 16.4.40. Appl. 17.10.36. Expansion well pump.

B. R. McKinley. U.S.P. 2,197,078, 16.4.40. Appl. 25.10.37. Formation tester.

S. F. Cunningham. U.S.P. 2,197,685, 16.4.40. Appl. 16.11.38. Means for controlling well flow, consisting of a bean with a barrel provided with many ports of various sizes, one of which is to be opened at a time by a reciprocating cylindrical valve, the other ports being closed.

T. R. Cowan. U.S.P. 2,197,778, 23.4.40. Appl. 20.5.38. Tubing protector particularly adapted to oil well tubings.

S. P. Hart. U.S.P. 2,198,435, 23.4.40. Appl. 30.8.38. Treatment of wells for removing mud sheaths by the action of an aqueous solution of an alkali metal perborate.

W. W. Robinson. U.S.P. 2,198,563, 23.4.40. Appl. 4.6.37. Method of completing wells using as a drilling fluid a suspension of bentonite, calcium carbonate, and water, and removing the sheath on the pay face by acid.

E. L. Davis, H. S. Cole, W. E. Larson, and N. C. Wells. U.S.P. 2,198,573, 23.4.40. Appl. 29.3.38. Method and apparatus for gravelling wells. A. H. N.

Transport and Storage.

922. Inhibition of Sulphate-reducing Bacteria by Dyestuffs. T. Howard Rogers. *J. Soc. chem. Ind.*, 1940, **59**, 34–39.—Bacteria which reduce inorganic sulphates with the production of hydrogen sulphide are of considerable economic importance because of corrosion by the hydrogen sulphide. Particular attention is directed to the corrosion of petroleum storage tanks and transports. Inhibition of these bacteria by the use of ordinary disinfectants is often impracticable, as the presence of the disinfectant may be itself objectionable. The article demonstrates that certain dyestuffs are eminently suitable for the purpose. Many dyestuffs have been tried, but those derived from 3 : 6-diaminoacridine (*e.g.* acriflavine and proflavine) are the best. These dyestuffs are non-corrosive and effective in concentrations down to 1 in 750,000, although 1 in 250,000 seems to be the most suitable concentration, depending, of course, on the strength of the bacteria. The application of the principle is covered by B.P. 497,829, 1938. T. C. G. T.

Gas.

923. Utilization of Natural Gas for Chemical Products. H. M. Smith. *U.S. Bur. Mines, Inf. Circ.* No. 7108, April 1940.—The manufacture of chemical products from

natural gas was retarded for many years owing to the prevalent belief that the hydrocarbons composing the gas were non-reactive. During recent years, however, research has shown that these hydrocarbons will react when activated by the effects of heat, pressure, chemical reagents and light, and that good yields of useful products can be obtained. This Circular describes by means of ten charts and relevant annotation the story of the manufacture of chemical products from natural gas.

The earlier charts give an indication of the general composition and major uses of natural gas; consumption in 1938 for domestic, commerical, and industrial purposes; basic methods of converting natural gas hydrocarbons into other products; and the relationship between various reactions that may be applied to ethane.

Charts VI, VII, VIII, and IX trace the development of chemical syntheses from primary products obtained by methods of hydrocarbon conversion previously described, *i.e.* decomposition, oxidation, halogenation, and nitration.

Finally, Chart X is devoted to the uses of non-hydrocarbon constituents of natural gas. Of these some are valuable even when present in very small quantities—*e.g.* helium. Others, such as hydrogen sulphide, are objectionable and must be removed. Certain natural gases are composed almost entirely of carbon dioxide which can be utilized for refrigeration purposes, fire extinguishers, food preservatives, etc., if the wells are easily accessible. H. B. M.

Hydrogenation.

924.* Hydrogenation of Boldesti Kerosine with Regard to Chemical Composition. C. Candea and J. Kühn. *Monit. Pétr. roum.*, 1940, **41**, 73–76.—The effect of various types of hydrocarbon on the hydrogenation of a kerosine from Boldesti crude has been investigated.

The original kerosine contained 4% unsaturateds, 13% aromatics, and possessed a specific gravity of 0·807. Hydrogenation conditions were 100 atms., initial pressure rising to 250 atms. and molybdenum oxide catalyst at 450° C. The yield was 53% of 150° C. end-point gasoline, which consisted of 60% paraffins, 28% naphthenes, and 7–8% aromatics.

The admixture of limited amounts (11%) of benzene or naphthalene effect no appreciable change in the yield, although the naphthalene is hydrogenated to tetrahydronaphthalene (tetralin).

Paraffin-wax hydrogenation is very susceptible to temperature, thus at 420° C. the yield of gasoline is 14%, while at 450° C. it is 71%. The gasoline so produced is 90% paraffinic.

Naphthenic acids from Rumanian gas oil under similar conditions are converted into naphthenes with production of carbon dioxide, whilst the unsaturateds in cracked kerosine or kerosine + amylene are completely saturated. T. C. G. T.

925.* Synthetic Gasoline Plants in Germany. M. N. Constantinescu. *Monit. Pétr. roum.*, 1940, **41**, 133–138.—The author estimates that Germany will produce 2,000,000 tonnes of synthetic gasoline in 1940. In 1933 production was 296,000 tonnes and in 1939 more than 1,300,000 tonnes. Production is equally divided among three groups: (1) the Leuna plants of the I.G. Farb., (2) the Bohlen, Magdeburg, Zeitz, and Schwarzheide plants of the Braunkohlen Benzine A.-G., (3) several plants in the Ruhr area belonging to Krupps, Ruhr Chemie A.-G., and the Rheinpreussen Co., etc.

The history of the development of the processes and the present-day technique are described. The article is largely based on a visit by the author to the Leuna works. The general scheme of the plant is presented diagrammatically, together with some photographs. T. C. G. T.

926.* Hydrogenation and Petrography of some Low-rank Coals from the Western United States. A. Eisner, G. C. Sprunk, L. Clarke, M. L. Fein, C. H. Fisher, and H. H. Storch. *U.S. Bur. Mines, Rep. Invest.* 3498, March 1940.—It is pointed out in this report that the time may come when petroleum is less plentiful, and when low-rank coals as found in the western United States will become an important source of liquid fuels and organic chemicals. There are vast quantities of these coals

available; in fact, the lignites and sub-bituminous deposits of Texas, North Dakota, Montana, Wyoming, Colorado, and other western States comprise more than half of the total coal resources of the United States.

While these coals cannot be used for the production of coke, and are generally inferior to the coals of the central and eastern States, they can nevertheless be converted into liquid motor fuel. Hydrogenation characteristics of a number of samples, including peat, brown coal, lignite, sub-bituminous coals, and low-rank bituminous coals, have accordingly been studied. The samples tested contained only small proportions of fusain and opaque attritus and the resin content was moderately high. 85–95% of the dry, ash-free coal substance was converted into liquid and gaseous products.

The higher oxygen content of sub-bituminous coal and lignite caused the formation of more water and carbon dioxide and less oil than in the case of bituminous coal, but liquefaction took place readily and yields were excellent considering the quality of the coal. H. B. M.

927. Patent on Hydrogenation. Synthetic Oils, Ltd. E.P. 519,722, 4.4.40. Appl. 31.8.38.—Production of hydrocarbon oils from carbon monoxide and hydrogen. A gaseous mixture containing carbon monoxide and hydrogen in a ratio of between 1 : 1 and 1 : 1·5 by volume is subjected to a catalysed synthesizing reaction. A product of the reaction boiling between 180 and 330° C., which is useful as a diesel oil, is segregated and treated by reaction, in the presence of a hydrogenating catalyst in conditions similar to those employed in the first reaction. H. B. M.

Synthetic Products.

928. Patents on Synthetic Products. E. I. Du Pont de Nemours and Co. E.P. 519,381, 26.3.40. Appl. 21.9.38.—Manufacture of maltosamines by reacting hydrogen with maltose and ammonia or a primary or secondary aliphatic amine in the presence of a hydrogenation catalyst.

Société des Produits Azotés. E.P. 519,570, 1.4.40. Appl. 24.6.38.—Direct manufacture of sulphur trioxide in the liquid state by causing a gaseous mixture, containing at least 30% of sulphur dioxide and at least sufficient oxygen to combine therewith, to pass over an active catalyst such as platinum or vanadium oxide. The sulphur trioxide formed is separated by direct condensation in the liquid state.

G. W. Johnson. E.P. 519,613, 1.4.40. Appl. 15.7.38.—Production of valuable liquid hydrocarbons from liquid carbon monoxide reduction products by catalytic treatment in the vaporous phase, preferably in the presence of hydrogen, *e.g.* by cracking or destructive hydrogenation. The formation of undesirable low-molecular hydrocarbons is considerably reduced by the addition of cyclic hydrocarbons boiling within the range of middle oils and which are at least partly vaporous under the reaction conditions.

W. Baird and A. G. Murray. E.P. 519,617, 2.4.40. Appl. 25.6.38.—Manufacture of *cyclo*-hexylbenzthiazylsulphonamides by oxidizing a *cyclo*-hexylamine salt of mercaptobenzthiazole in which each carbocyclic ring may carry a methyl substituent.

G. T. Morgan and J. Stewart. E.P. 519,660, 2.4.40. Appl. 28.9.38.—Manufacture of mono-nitro-1 : 3-diazalines by heating a dinitro-secondary amine, preferably in a medium of high boiling point, until nitrous fumes are evolved.

F. Meyer. E.P. 519,661, 2.4.40. Appl. 20.11.37.—Process for obtaining water-soluble, polyhydroxyl amino-aromatic sulphonamides from amino-sulphonamides by reacting an amino-aromatic sulphonamide with an aldose.

Society of Chemical Industry in Basle. E.P. 519,683, 3.4.40. Appl. 22.9.38.—Manufacture of melamine from dicyandiamide or cyanamide with addition of liquid ammonia. The conversion is begun at a temperature not substantially above 110° C., and then, while the ammonia is being distilled off, it is completed at a higher temperature and under a pressure lower than 200 atoms.

Bakelite, Ltd. E.P. 519,721, 4.4.40. Appl. 30.8.38.—Dealkylation of alkyl-substituted phenols to obtain lower phenolic homologues by passing a mixture of hydrogen and an alkyl-substituted phenol over a heated catalyst obtained solely by heating nickel sulphide, or the silicate, oxide, or sulphide of barium, cadmium, iron, aluminium, or zinc, in a finely divided form in an atmosphere of hydrogen.

E. I. Du Pont de Nemours. E.P. 519,750, 4.4.40. Appl. 30.9.38.—Preparation of alkali metal salts of sulphuric esters of long-chain aliphatic alcohols in extruded form by neutralizing a sulphuric ester of a long-chain aliphatic alcohol with a concentrated aqueous solution of an alkali metal base, in the presence of an inert solid diluent, and preferably under reduced pressure, and effecting extrusion of the neutralized mass in the form of threads or needles.

Society of Chemical Industry in Basle. E.P. 519,776, 5.4.40. Appl. 14.9.38.—Manufacture of derivatives of fluoranthene by causing a halogen substitution product of fluoranthene to react with a compound containing at least one hydrogen atom combined with nitrogen and the radical of a compound capable of being vatted.

Houdry Process Corporation. E.P. 519,808, 5.4.40. Appl. 4.10.38.—Manufacture of contact masses for use in the treatment, conversion, or production of fluids, including hydrocarbons and their derivatives. A zeolitic body is formed from reactant solutions and afterwards treated with a solution, incapable of dissolving nuclear substance by acid reaction, and containing a volatile or unstable cation capable of base exchange. H. B. M.

Refining and Refinery Plant.

929.* Treating High Sulphur Cracked Distillate with Acid Process. F. A. Apgar and C. A. Day. *Oil Gas J.*, 28.3.40, **38** (46), 187.—A description, with flow sheet and test-run data, is given of a Stratcold treating plant installed at a Watson (Calif.) refinery and designed to treat 11,000 brl. per day of heavy cracked naphtha with 9 lb. of 98% H_2SO_4 per brl. in three stages, at 30° F., 30° F., and 20° F., respectively. Each stage consists of a chiller, horizontal refrigerating contactor and sludge settler. The naphtha is cooled to treating temperature in a shell-coil ammonia chiller and passed to the contactor, where acid and distillates are rapidly circulated by an impeller over tubes cooled by ammonia. The treated material is then passed upwards through a clarifier or rock packed tower, water washed and neutralized with NaOH solution. Mercaptan sulphur was reduced in one test from 50 to 2 mgms. per 100 c.c., with a treating and polymer loss of 5·54%, and octane number loss of 1. Caustic soda consumption for neutralization is 0·06/0·08 lb. per brl., and electric power consumption 0·7/0·9 kw. per brl. C. L. G.

930.* Measuring Internal Diameter of Still Tubes. W. A. Howard. *Oil Gas J.*, 28.3.40, **38** (46), 78.—The accurate measurement of the internal diameter of still tubes is reduced by the presence of scale, the varying lengths and diameter, and the general inaccessibility of such tubes. An internal electro-caliper has been devised and is now in use at several refineries. It gives direct readings in any diametrical plane, accurate measurement of small pockets and grooves, and is rugged and rapid to manipulate. Measurement is made in the de-scaled tube by the motion of two opposing plungers expanded by spring pressure and geared to a common rotating shaft. A special type of wire-wound potentiometer is mounted about the rotating shaft, and the variation in voltage obtained through the potentiometer, due to the movement of the plungers and the rotating of the potentiometer arm, is transmitted by an electric current through a voltmeter calibrated directly in inches. A pair of plungers covers a range of measurement of $\frac{1}{2}$ in., extensions and centring springs being provided for larger tubes. An accuracy of 0·005 in. is possible with this instrument. By the addition of suitable arms it is possible to use the instrument as a gauge for the presence of oversize areas.

A complete picture of the size of the tube may be obtained by the addition of external tube calipers equipped with a dial gauge. C. L. G.

931.* Oxidation of Thiophen-sulphur by Calcium Hypochlorite Solution. E. G. R. Ardagh, W. H. Bowman, and A. S. Weatherburn. *J. Soc. chem. Ind.*, 1940, **59**, 27–28.—Factors influencing the proportion of thiophene-sulphur converted into sulphate as a result of the oxidative action of calcium hypochlorite solutions are discussed. The range of pH values found most effective for the oxidation of thiophen by this method is in the neighbourhood of 8 to 7. T. C. G. T.

932. Patent on Refining. N.V. de Bataafsche Petroleum Maatschappij. E.P. 519,397, 26.3.40. Appl. 21.10.38.—Process for the removal of mercaptans from an alkaline-reacting mercaptide solution. H. B. M.

Analysis and Testing.

933.* Occurrence of Free Sulphur in Lignite Coke. E. Graefe. *Oel u. Kohle*, 1940, **36**, 14–19.—The presence of free sulphur was demonstrated by extracting samples of four types of lignite coke with carbon disulphide and removing the solvent by evaporation. Only in one case were the typical yellow crystals formed, the other samples yielding oily drops. In each instance, however, the product was proved to be elementary sulphur by reaction with a silver mirror. This method had to be used on account of the minute amounts being dealt with, the estimated weight of one crystal being 0·00002 mg. The article is illustrated with microphotographs. T. T. D.

934.* Estimation of Lead in Ethyl Fuels. H. Siebeneck. *Oel u. Kohle*, 1940, **36**, 16–17.—The author describes a colorimetric method which takes only 45 min., compared with the 4–5 hr. required by the standard method.

The fuel is treated with Br and the lead bromide converted into nitrate in the usual manner. The nitrate solution is either evaporated to dryness and taken up in distilled water and a little HNO_3, or neutralized with ammonia and made just acid with HNO_3. An aliquot of this is treated with an ammonium chloride-glycol buffer, and standard sodium sulphide solution added. This forms a brown solution, which is compared in a colorimeter with a similarly treated standard lead solution containing 0·1 mg. Pb/ml.

The author describes the modification necessary when dealing with highly olefinic gasolines. He contends that this method is very accurate and agrees excellently with the gravimetric estimation, while taking one-sixth of the time. T. T. D.

935. Equilibrium Cell for Investigating Properties of Fluids from Petroleum and Natural-gas Reservoirs. K. Eilerts, R. V. Smith, and R. C. Wright. *U.S. Bur. Mines, Rep. Invest.* No. 3514, April 1940.—The term "combination well" has been applied to those wells from which gas and light volatile hydrocarbon liquid in quantities of economic significance are recovered at a relatively high ratio of gas to liquid. During the course of development and operation of such wells many new problems have arisen, the solution of which depends on an intimate knowledge of the characteristics of the fluids produced at the relatively high pressures obtaining in the reservoirs.

It was found impossible to predict the behaviour of these fluids by comparing them with that of low gas–liquid ratio fluids at identical pressures and temperatures. Accordingly, in order to obtain the desired experimental information, an equilibrium cell was constructed at the Petroleum Experimental Station of the Bureau of Mines, Bartlesville, Ohio.

This report contains a full account of the cell, which is designed to operate at pressures up to 5000 lb. per sq. in. absolute and for the range of temperatures common in the production of petroleum. The cell is capable of measuring dew point, saturation pressure, and specific volume of hydrocarbon mixtures. In addition, phases of natural hydrocarbon mixtures in equilibrium can be provided by means of the apparatus for subsequent sampling and analysis by fractionation.

It is hoped that when sufficient experimental data have been accumulated, it may be possible to make dependable estimates of the phase relations for high gas–liquid ratio fluids at the pressures and temperatures characteristic of "combination well" reservoirs. H. B. M.

936.* New Method of Gas Analysis. W. J. Gooderham. *J. Soc. chem. Ind.*, 1940, **59**, 1–8.—The simplest form of gas analysis can be obtained by passing gas through a series of accurate metres and absorption reagents and recording the gas flow after each absorption.

Accurate gas meters have been developed by timing the rate of travel of a soap film pushed by the gas through a calibrated vessel. The soap films are produced by solutions of "Igepon" and "Aerosol," these latter being the proprietary names of certain complicated organic sulphonates.

Using diaphragm pumps, a new form of gas holder made of corrugated metal rings, and a special type of governor, average gas samples can be readily collected, stored under pressure, and analysed.

The advantages claimed for the method are :—

(1) Accurate results, which can be quickly repeated, are obtained in a few minutes from stop-watch readings.

(2) There are no taps or mercury to clean, only reagents to be replaced.

(3) Breakages do not occur; the moving parts revolve easily, the apparatus is not handled, and it is completely enclosed.

(4) New reagents, which attack mercury and tap grease, can be used (*e.g.* activated nitrating mixture for unsaturated hydrocarbons).

(5) The use of mercury, with the attendant dangers of poisoning, is avoided.

(6) Appreciable errors due to the dissolution of gases in reagents and of absorption of carbon dioxide on the oxides are obviated.

(7) There is no appreciable dead space in the apparatus, the soap is churned up by a spiral, and thus brought more readily into equilibrium condition with the gas. T. C. G. T.

937.* Determination of Dissolved Oxygen in Gasoline. W. A. Schulze, J. P. Lyon, and L. C. Morris. *Oil Gas J.*, 28.3.40, **38** (46), 149.—A description is given of a modification of the manganous hydroxide–iodine method for the determination of oxygen in water, which has increased its accuracy and enabled it to be used for the field testing of dissolved oxygen in gasoline. The test is carried out by introducing 100 ml. distilled water and 10 ml. $MnSO_4$ solution (480 gm. $MnSO_4.4H_2O$ per litre) into a calibrated sampling bottle, removing the air by evacuation, and flushing with air-free propane or nitrogen, and 7 ml. of alkaline iodide solution (700 gm. KOH or 500 gm. NaOH + 150 gm. KI per litre), followed by 8 ml. of distilled water. Manganous hydroxide is precipitated and the gasoline is introduced, followed by vigorous shaking for 1 hr. The aqueous solution is carefully separated and the liberated iodine titrated with standard thiosulphate solution. With straight-run gasolines the test is accurate to within $\pm$ 5%, but with cracked gasolines the absorption of iodine by the unsaturateds present causes inaccuracies.

Full details of the test and precautions necessary are given. C. L. G.

Motor Fuels.

938. Patent on Motor Fuels. A. McKellar. E. P. 519,855, 8.4.40. Appl. 4.10.38.—Production of a blended fuel by dissolving an alkali in alcohol and then adding the result to a fat or fatty acid until the product is neutral. The said neutral product is used as a blending agent to blend a hydrocarbon fuel with hydrous alcohol. H. B. M.

Diesel Fuels.

939.* Characteristics of Diesel Fuels Influencing Power and Economy. A. J. Blackwood and G. H. Cloud. *J. Soc. aut. Engrs*, 1940, **46** (2), 49–53.—This paper presents

data obtained during an extensive fuels research programme and deals very largely with power and fuel economy obtained when using fuels of varying physical and chemical characteristics. Engine performance characteristics, such as smoke, cold starting, carbon formation, ring sticking, are not dealt with. The authors present all data relating to fuel economy on a volume basis, in preference to a weight basis, as they point out that diesel fuels are invariably sold by volume, and results based on weight are therefore apt to be misleading.

A selection of gas oils from widely different crudes were each fractionated into four cuts of approximately 100° F. boiling range, providing in all about 30 fuels. The majority of the tests were run on a 6-cylinder, $3\frac{1}{4} \times 4\frac{1}{2}$ ante-chamber engine. Tests on fuels of various mid-boiling points having the same cetane number show that volumetric fuel economy improves with increasing mid-boiling point, which is no doubt due to the fact that, for either constant gravity or cetane number, an increase in mid-boiling point is accompanied by a corresponding increase in B.T.U.'s per gallon. As speed increases from 800 to 2400 r.p.m. the effect of cetane number is gradually reversed, the lower-ignition-quality fuels showing the best volumetric economy at the lower speeds, and the higher-ignition fuels being better at the higher speeds. It is stated that as speed increases ignition lag becomes more significant and consumption deviates from the heat content basis in favour of cetane number, whilst at the lower speeds ignition lag is of less importance, and the reverse is true. Tests on the effect of viscosity on pump leakage show that power loss from this cause can better be remedied by keeping the pumps in good mechanical condition than by using fuel of higher viscosity.

Assuming complete combustion, fuel volatility affects the specific volumetric consumption only in so far as it is related to heating value and ignition quality. An interesting chart shows the cross-relationship of heating value, ignition quality, and viscosity to other fuel properties commonly available from routine fuel inspections.

C. H. S.

Lubricants and Lubrication.

940.* Lubrication of I.C. Engines with Mineral Oils Compounded with Stabilized Vegetable Oils. M. Freund and St. Thamm. *Oel u. Kohle*, 1940, **36**, 18–22, 55–57.—The most suitable inhibitors and blends for use in engine tests were determined by laboratory oxidation. The method used was to pass oxygen at 2 bubbles/sec. for 5 hr. through 60 ml. of oil maintained at 200° C. Specific gravity, viscosity at 50°, acid value, and Conradson number were determined before and after oxidation, to assess stability. The oils investigated were castor oil and olive oil, rape oil with and without inhibitors, and, for comparative purposes, a Rumanian mineral lubricating oil. From the results obtained it was inferred that in the presence of a suitable inhibitor, rape oil is as satisfactory as the stable vegetable oils.

Engine tests were carried out in a single-cylinder four-stroke water-cooled petrol engine directly coupled to a dynamo, so that its output could be measured. Owing to the viscosity requirements of the engine, pure rape oil could not be used in it, so tests were run on a mixture of rape oil and blown rape, with and without inhibitors; on rape-mineral oil blends containing an inhibitor; and on soluble castor-rape-mineral oil blends.

Full tables are given of the results obtained, and photographs illustrate the condition of the cylinder and piston at the end of various runs.

The results of the tests showed that a great improvement in the condition of the engine was apparent if inhibitors were used, compared with the unstabilized vegetable oils. Compared with mineral oils, rather more carbon was deposited in the combustion chamber, but analysis of the sump oil and performance of the engine were similar. In the authors' opinion, stabilized rape oil is quite satisfactory for the lubrication of I.C. engines.

T. T. D.

Asphalt and Bitumen.

941. Report of the Road Research Board for the Year Ended 31st March, 1939.—The investigation of soil problems has been continued, and new apparatus has been

constructed for taking undisturbed soil samples and for carrying out consolidation tests. The value of soil surveys has been confirmed, and the Ministry of Transport has made increasing use of these before laying new trunk roads. Laboratory tests indicate that mechanical compaction of soil merely causes a reduction in air-voids and does not expel moisture from the soils, thus limiting the degree of compaction obtainable. The addition of binder was found to cause a considerable increase in the volume of a given weight of soil. Experience gained with earth roads stabilized with bituminous emulsions or concrete indicated that it is inadvisable to lay bituminous stabilized soil after July, since it would not dry out properly.

It has been found unnecessary to use many sizes of sieves for an aggregate grading analysis, and the B.S.I. now recommend only twenty sieves, ranging from 200 mesh to 3 in., whilst for many purposes only eleven sieves are necessary. The distribution of particle size in a " single-sized " aggregate can be expressed in terms of the mean size and standard deviation, and thus a consistent degree of quality can be obtained by specifying the limits of variation from the nominal size. Tables giving the covering power of chippings for any grading, size, or shape have been drawn up, but their utility is limited at present by the variability of chipping sizes. The aggregate crushing test, which measures the percentage passing a 7-mesh sieve after crushing ¾–½ in. under 40 tons, has been standardized. Improvements have been effected in equipment for mechanical tests on bituminous materials, and preliminary tests have been made on the transient load-testing machine to duplicate loads on the roads. Marked changes in the mechanical properties of aggregate-filler binder mixtures with and without sand have been found to occur when the optimum proportion of the filler-binder constituent is exceeded. Investigation of methods of designing bituminous mixtures on a basis of simple laboratory tests has reached the point at which it is felt that full-scale trials are justified and arrangements have been made for these, varying the quantity and nature of the binder, filler and coarse aggregate in order to vary the mechanical properties.

The co-operative work with the Asphalt Roads Association has been continued and the range of bitumens has been extended to include some abnormal materials which may throw light on some factors which affect normal bitumens. Further study of the visco-elastic properties of asphalts by means of modified Couette and Ostwald viscometers shows that when a bitumen is subjected to constant stress the resulting shear exhibits elastic, thixotropic, and viscous flow components, and if applied for a sufficient length of time, the rate of shear ultimately attains a constant value. It also appears that in comparing one bitumen with another differences in plastic and elastic properties are of more practical significance than differences in temperature coefficients of viscosity. The mechanical properties of laboratory prepared mixtures are being examined and compared with those obtained from the road. The essential properties appear to be the rate of deformation under unit stress, the plastic flow index, the temperature coefficient of deformation, and the extensibility. Sections laid on the Colnbrook By-pass, some with shortage of fines to accelerate failure, have in general hardened considerably, as shown by the resistance to deformation, but this is not shown by a corresponding fall in the penetration of the recovered bitumen. Work has also been commenced on the effect of weather on the properties of bitumens.

The co-operative work with the Road Tar Research Committee has been continued with similar aims, and an attempt is being made to relate the durability of tar under road conditions to the results of durability tests made in the laboratory. For this purpose tars made by a number of different processes, etc., including those containing up to 10% of bitumen, have been used. The mechanical properties of sand–filler–tar mixtures have also been examined. It has been found that for both asphaltic bitumen and tar binders the temperature coefficients of deformation of laboratory prepared specimens are the same as those of binders alone. Full-scale work is being carried out with tar-chlorinated rubber mixtures in conjunction with the British Rubber Producers Research Association. The method of preparing the mixtures has a great influence on the resultant properties; as well as improving the elastic recovery of tars, chlorinated rubber markedly increases the adhesive properties. Granular dispersions of latex and vultex in bitumen are also being investigated, and show increased elastic characteristics and adhesion.

Various technical improvements have been made in the methods of analysing bituminous mixtures, and it is found that pure benzene gives better results in recover-

ing bitumen than does carbon disulphide, since the latter is particularly affected by the presence of water. A technique has also been evolved for recovering liquid binders of a wide range of viscosity from solution.

The experiments to compare results on the Colnbrook By-pass with those on the road machine have been continued. In many cases the carpets were designed as the result of road failures elsewhere, and their unexpectedly long life may be due to the long time allowed before traffic was permitted or to the accurate carrying out of specifications. The work on No. 2 Road Machine, using solid rubber tyres, a moderate temperature, and a constantly wet surface, has shown that it places materials in a different order from that obtained on the road, since the types of failure found are different. There appears to be little doubt that the development of the best type of road machine must include provision for control of temperature and moisture conditions similar to those found in practice, otherwise serious anomalies arise. It is noted that with failures on No. 1 Road Machine the displaced stones are in general well coated on their undersides with binder, and this machine and No. 3, both with pneumatic tyres, reproduce the type of wear found on the road, although the use of continuous wet testing is open to question.

Laboratory tests on the use of hydrochloric acid to reduce the slipperiness of smooth concrete surfaces have been continued on a full scale, and it has been shown that the method is practicable and cheap. A considerable amount of work is being carried out to improve the skidding resistance of wood-block surfacings, and the use of a cast-iron surface with much smaller studs has increased the sideway force coefficient (s.f.c.) from 0·25 to 0·45. Since tyre-tread rubber hardness and viscosity of water both decrease with rise of temperature, these two effects tend to cancel each other with regard to the s.f.c.; it is also independent of the degree of wetness of the road. By means of texture prints it has been found that open-textured tar or bitumen carpets show little change, but that the close-textured either become progressively smoother or self-roughened owing to uniform abrasion. Some of the phenomena of slipperiness, such as the large seasonal variations, are not yet fully understood, and it is hoped that further data will be obtained on a special 2000 ft. long skidding track. The track will also form a useful calibration surface for the various machines used by the laboratory for studying the non-skid properties of roads, and will be used for tests for weathering only on bituminous surfacings.

The apparatus for carrying out tests on skidding at high speeds was completed during the past year, and a few tests have been made at 70 m.p.h. Results show that the s.f.c. continues to decrease at the higher speeds. By means of a cathode-ray oscillograph the maximum normal pressure under a tyre moving at 0–40 m.p.h. has been found to be approximately 1·5 times the inflation pressure. By this means also measurements of the horizontal shear stresses have also been made, and one interesting indication already obtained is that whereas these stresses are compressive in character under a pneumatic tyre, due to excess tensile forces in the tyre, they are tensile under a solid tyre.

The statistical investigation of the traffic and weather on the Colnbrook By-pass has been continued, and it has been found that the most densely trafficked strips of the 30 ft. wide road occur at 9–10 ft. from the kerb. After any prolonged period of sunshine the temperature of the road surface is greatly in excess of that of the air, being higher the darker the road, whilst in dull weather it approximates to that of the air. The lowest temperature observed for an asphalt surface was — 6·5° C., and the highest 48° C. The average daily loss of stones per week from the Colnbrook By-pass thin surfacings has been found to be inversely proportional to the minimum temperature for that week. H. G. W.

942. Patents on Asphalt and Bitumen. Standard Oil Development Corporation. E.P. 519,463, 27.3.40. Appl. 15.9.38. Improvement in the adhesivity of bituminous compositions comprising a bitumen cutback or emulsion by the addition of a phenolic compound of a metal.

Naamlooze Vennootschap Maatschappij tot Beheer en Exploitatie Van Octrooien. E.P. 519,549, 29.3.40. Appl. 3.10.38.—A binder consisting of a mixture of finely divided, inorganic material and an organic bituminous substance capable of pyrolytic reaction is incorporated with a mass of glass fibres to produce a tough, strong product of low density. H. B. M.

Special Products.

943.* Recent Development in the Field of Synthetic Rubber. H. Mark. *Chem. and Ind.*, 1940, **59**, 89–90.—The article represents a digest of a review presented to the Montreal section of the Society of Chemical Industry. Developments in production and the desirable features of the synthetic rubbers are outlined. T. C. G. T.

944. Studies of Carbon-black. V. Effect of Gas Composition on Production and Properties of Carbon Obtained by Non-Impingement Methods. L. M. Pidgeon. *Canad. J. Res.*, 1939, **17**, 353–363.—Lamp-black is produced from hydrocarbon gases, methane, ethylene, and propane, by burning them in restricted air supply. The carbon is removed from the burnt gases by filtration. Maximum yields are obtained when the combustion tube is heated externally at 550–1100° C. and when an air/gas ratio slightly below theoretical is used. Under these conditions the yields are ethylene 8·3 lb./1000 cu. ft., 85% methane + 15% ethane: 3·9 lb., 70% propane + 30% butane – 13 lb.

The carbon from burning olefins resembles carbon-black in its ability to reinforce rubber, whilst the carbon from paraffins resembles lamp-black and does not reinforce rubber.

Experimental data are summarized in tables and graphs, and a diagram of the combustion apparatus is included. T. C. G. T.

Coal and Shale.

945. Patent on Coal. N.V. Nieuwe Octrooi Maatschappij. E.P. 519,310, 21.3.40. Appl. 17.9.38.—Process for the production of coke with a very low volatile content. A hydrocarbon mixture is separated by heating into a relatively light vaporous part and a relatively heavy liquid part. The vaporous part is cracked and the products are cooled. The heaviest fractions are thereafter separated in liquid form and passed into one or more liquid cracking chambers in which cracking to coke is effected while passing heat carrier gas therethrough. H. B. M.

Economics and Statistics.

946.* Rumania's Internal Consumption of Petroleum Products. Anon. *Monit. Pétr. roum.*, 1940, **41**, 189–196.—Rumania's own consumption of petroleum products is tabulated for each of the ten years 1930–1939. In 1939 the home consumption was 1,784,750 tonnes (out of a total production of 5,962,321 tonnes), consisting of: light gasoline 134,228; heavy gasoline 29,353; kerosine 193,903; gas oil 126,836; special fuels 133,264; heavy fuel 1,077,235; lubricating oil 25,253; asphalt 45,348; wax 3814; and coke 15,516.

The increase in consumption from 1,674,046 tonnes in 1938 is shared by all products with the exceptions of heavy spirit and coke, both of which register declining consumption.

Over the ten years figures recorded the most notable increase has been that of asphalt. In 1930 only 6701 tonnes of this product were consumed, against 45,348 tonnes in 1939. This represents 577% increase, compared with only 42% increase in the grand total consumption.

Further tables illustrate the amount of each product contributed to home consumption by most of the oil companies operating in Rumania, and also the amounts consumed by these companies for their own use. T. C. G. T.

947.* Developments in the Prices of Rumanian Petroleum Products During 1939. Anon. *Monit. Pétr. roum.*, 1940, **41**, 123–130.—The gradual increase in the prices commanded by exported Rumanian petroleum products during 1939 shows a rapid increase during the critical months of the summer. Motor spirit in particular showing more than 100% increase between March and December.

The prices are closely analysed and discussed in relation to the fluctuation of the American prices and to the international situation. The article consists largely of tables of prices which should be consulted. T. C. G. T.

948. Survey of Fuel Consumption at Refineries in 1938. G. R. Hopkins. *U.S. Bur. Mines, Rep. Invest.* 3485, Dec. 1939.—According to this report the average amount of heat units required to refine a barrel of crude oil rose from 562,000 B.T.U. in 1937 to 567,000 B.T.U. in 1938. This increase was due chiefly to the decline in total runs to stills. Additional crude runs give lower average heat requirements because they involve comparatively small amounts of auxiliary heat and also because they represent simple topping arrangements. Thus it is that the decline of 1·6% in crude runs to stills in 1938 reflected only an 0·4% decrease in total heat consumption. The rise in average heat requirement per barrel might also be partly explained by the fact that the aggregate yield of complex products requiring more operating steps to produce increased in 1938 by about 1%. In spite, however, of the influence of crude runs on average heat requirements, there was noted definite improvement in firing efficiency, due to increased use of heat-exchangers, the development of combination units, and the trend from solid to gaseous fuels. H. B. M.

BOOK REVIEW

Lubricants and Lubrication. By James I. Clower. Pp. viii + 464. McGraw-Hill Publishing Co., Ltd., London. 1939. Price 33*s*.

A considerable amount of work has been published on the subjects of lubricants and lubrication, mostly scattered in scientific and technical journals for the information of those engaged on more fundamental problems, but there is still a paucity of literature dealing with them in a comprehensive manner which is suitable for the practical engineer.

Most books of this nature are usually unbalanced, in that they either have a strong leaning towards the chemical and physical side of the study of lubricants, or they are overweighted with practical engineering details dealing with the subject of lubrication itself. No criticism of this book can be made on this score, as the author has shown himself to possess a wide knowledge of both branches.

Few users of lubricants have more than an obscure idea of the source, production, and refining of petroleum and its products, and the first three chapters of this volume deal with these subjects clearly and quite adequately for the purpose in mind. A description of the physical and chemical properties of the fixed oils and fats, together with their refining and uses for compounding purposes, then follows.

The majority of books on lubricants are content to describe the manufacture of greases as an art which depends largely on the experience of the maker, but the author explains how the manufacture of both lime-base and soda-base greases has now passed into the hands of the laboratory chemist, who, with the aid of scientific temperature-measuring and control instruments, improved weighing and measuring devices, and easily regulated steam-heated kettles, is able to govern his methods scientifically. That section of the chapter which deals with physical tests is comprehensive, and a valuable table is given of the classification, composition, and uses of various classes of greases for many purposes.

No book on this subject would be complete if it did not include a description of the standard chemical and physical tests employed in the evaluation of lubricating oils, but in this case more attention has been given to the significance of such tests than to their details, which latter information can be obtained by turning to the A.S.T.M. official references which are given in each case. Care has been taken to explain that the results of such tests may bear little relation to actual service performance, and that they give no indication of the lubricating value of oils. The mechanical testing of lubricants is also dealt with in a clear manner, and the Almen, Timken, and S.A.E. machines for testing extreme pressure lubricants, as well as the Herschel instrument, are described, but it is emphasized that these are capable of evaluating lubricants only in terms of wear, scuffing, seizure, and perhaps film strength. The author has wisely refrained from expressing an opinion as to whether any correlation of results is possible between them, or whether reproducible readings can be obtained from any particular apparatus with any degree of accuracy.

In the chapters dealing with the fundamentals of lubrication, the principles of the various types of friction met with in moving parts, and of viscosity and shear, are explained clearly and simply. The accepted conception of oil-film formation and film rupture are also described in detail, and practical hints are given in regard to grooving. Engineers will also find brief hints on the lubrication of ball and roller bearings in the succeeding chapter.

Two subjects which are of considerable economic importance to bulk oil-users are oil purification and also storing and handling. In describing mechanical purifiers such as gravity settlers, centrifuging plant, pressure and streamline filters, and other devices, readers are warned that lubricating oils become unfit for further use, not because they "wear out" or lose their lubricating properties, but on account of the fact that they undergo certain chemical and physical changes which may be aggravated by catalysis, quite apart from any question of contamination with foreign substances. For the guidance of those responsible for storing oil in

bulk, a detailed diagram of a central oil-storage house is given and other means of storage are discussed.

Those portions of this book which will appeal most to the engineer are, first, Chapter IX, which deals with oiling and greasing appliances commencing with the simple oil-cup and grease-gun, and leading up to the most complicated methods of lubrication for all types of machinery and plant, and also Chapters XII–XVI, which together fill practically half of the volume.

In these later chapters are to be found descriptions of the arrangement and construction of steam engines and turbines, internal-combustion engines, compressors and refrigeration machinery, as well as their lubrication problems, such as is rarely met with in such detail in technical books of this character. In writing of the internal and external lubrication of steam engines, the author has dealt fully with the various methods and devices, which depend on heat, pressure, centrifugal force, absorption, baffling, and filtration, for the purpose of separating oil from steam and condensate; a subject which, although it may scarcely be classified under the heading of lubrication, is, nevertheless, the direct result of essential lubrication, and is of extreme importance to the steam engineer.

The various methods of lubrication of internal-combustion engines are dealt with fully and the cycles of operations and the types of fuels are also taken into consideration. Finally the cause of ring sticking, blow-by, cylinder wear and ring wear are discussed in an interesting manner.

Some readers will find, no doubt, much which is familiar to them in this book, but the author claims nothing more than that it is "essentially practical"—presumably this is the reason why no references to cognate literature are given—and that it is intended as a book of reference for "buyers, sellers and users of lubricants and for those who design and operate machinery."

This book can be highly commended not only to such readers, but also as a practical treatise to students of engineering and petroleum science, and to those theorists whose knowledge of lubricants and lubrication does not extend beyond laboratory technique.

The diagrams and drawings are very clear indeed, particularly in detail, and the print and blocks are up to the publishers' usual high standard. A. W. NASH.

BOOK RECEIVED

Oil and Petroleum Year Book, 1940. Walter E. Skinner, 15 Dowgate Hill, London, E.C.4. Price 10*s*.

The present volume is the thirty-first annual issue of this well-known year-book of reference to the commercial structure of the oil industry. With one exception, all the customary features of previous volumes are included. The exception is the section of statistics of company crude production, the inclusion of which was prohibited in the national interests.

The company records section covers references to 775 companies engaged in every branch of the industry throughout the world, and is supplemented by comprehensive lists of the names of more than 3300 executives connected with these companies. Other useful sections include a list of 813 trade names of proprietary petroleum products, Statistics of World Crude Production since 1931, and a Glossary of Technical Terms.

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The assistance of the Director of Fuel Research of the Department of Scientific and Industrial Research is acknowledged in the preparation of those abstracts appearing above the initials D. F. R.

Geology.

949.* Subsurface Geology of Chester Series in Illinois. L. E. Workman. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 209–224.—Occupying most of the southern half of Illinois, all the formations of the standard Chester series can be identified in the area.

A geological map and two cross-sections are furnished, showing the stratigraphic relations of the formations. These are mainly conformable and similarly so with the underlying formations of the Iowa series of the Mississippian. Warping, uplift, and peneplanation prior to the deposition of the Pennsylvanian have resulted in truncation of the beds throughout the basin.

Production has come mainly from the lower part of the Chester series below the top of the Cypress sandstone, and also from the upper part of the underlying St. Genevieve formation. The maximum thickness of the Chester series (shown on an isopach map) is 1450 ft. Two important pre-Pennsylvanian anticlines are indicated. In these are located the major number and features of the Illinois oilfields: one, the La Salle anticline, and the other, the uplift which extends south-east from the Sorento region.

G. S. S.

950.* Subsurface Geology of Iowa (Lower Mississippian) Series in Illinois. J. N. Payne. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 225–236.—The Iowa series lie below the Chester group, and their definite separation depends on insoluble residues; but their distinctive lithologies can be used for correlating. The Meramec, Osage, and Kinderhook groups are defined.

The Meramec consists of the St. Genevieve, St. Louis, and Salem formations, which include cherty and oolitic limestones and dolomites. Oil production is from all three formations, and especially from the Fredonia member of the St. Genevieve, which readily lends itself to separation by means of insoluble residues. The Osage shales and cherty limestones are doubtful oil producers, whilst the Kinderhook group is mainly structureless shales.

The thickness of the Iowa series has been determined by isopachs (a map of which accompanies the paper) and a maximum of 2000 ft. has been obtained in Gallatin Co. The La Salle and Carlinville–Centralia anticlines, folded in pre-Chester times, have been revealed by thinning of the series.

G. S. S.

951.* The Type Permian; its Classification and Correlation. C. O. Dunbar. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 237–281.—The major part of this paper describes the Permian Basin west of the Urals, and is accompanied by maps and sections to illustrate the location and stratigraphy.

The region is divisible into two dominant structural elements—the Russian Platform and the Uralian Geosyncline. The pioneer work of Murchison in defining the Permian System is discussed and an analysis of the stratigraphy of the Permian Basin, as known at present, is given. In addition, the Middle and Upper Carboniferous beds of the basin are described; these include the zone of *Triticites*, which thins rapidly westward from the geosyncline, and is represented in the Moscow Basin by the well-known Gshelian.

The writer stresses the ambiguity of the term "Uralian," which was given to a

series of limestones at the base of the Permian and at the top of the Carboniferous. This term was used by De Lapparent and Tschernyschew to denote a time-phase, but is here considered to represent only a facies. Tschernyschew's work in correlating limestones in the Timan and Ufa plateaux is shown to be partly erroneous, as the Ufa plateau section continues much higher stratigraphically than that of the Timan. It is suggested that " Uralian " be abandoned or given a more precise definition.

The Permian is divided into five series: the Sakmarian, Artinskian, Kungurian, Kazanian, and Tartarian. The Sakmarian is the *Pseudoschwagerina* zone, and its reef structures (the Shikhans) are described. The Artinskian shales, sandstones, and conglomerates are considered to be the equivalent of part of the Ufa plateau limestones (Uralian), whilst the salt-bearing series (Kungurian) vary greatly in lithology and thickness. The Tartarian are continental deposits of redbed facies and occupy the central part of the basin; they are not of great thickness, the upper part being included in the Triassic.

The Russian section is correlated with the areas of marine Permian in the south-west United States and in South China; the Permian fusuline zones are useful in such correlation.

Deposition continued in the Russian basin from Middle Carboniferous into Upper Permian with only minor interruptions. The greatest physical change came at the beginning of the Sakmarian, when the Uralian geosyncline began to deepen rapidly and when also a marked faunal change took place with the sudden appearance of the genera *Schwagerina*, *Pseudoschwagerina*, and *Paraschwagerina*. In America and in South China there is a similar widespread break below the same faunal zone—a correlation which suggests that the base of the *Pseudoschwagerina* marks the beginning of Permian times. G. S. S.

952.* Carboniferous–Permian Boundary. R. C. Moore. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 282–336.—The problem of the definition of the boundary between the Carboniferous and Permian is here reviewed in the light of the requisites and purposes of a systematic classification. The geological system, as a major stratigraphical unit, was first conceived by English geologists, and in the definition of boundaries of the various recognized systems the following criteria have been used: (1) unconformities, (2) palæontological breaks, (3) marked changes in lithologies. Substantial agreement in usage is more important as a factor in definition of boundaries than priority of definition. It is preferable to have a standard classification that is understood by all, and geological practice demands that definition of the boundaries of the Carboniferous and Permian systems in Europe and North America should be in agreement.

The Carboniferous–Permian boundary in England, Russia, and North America is discussed critically. In England, except possibly in Warwickshire, the hiatus in the position of the boundary is very considerable. Russian geologists have placed the beds of the *Pseudoschwagerina* zone in the Upper Carboniferous and the Artinskian strata, immediately above, in the Permian. This has been contested by C. O. Dunbar, who states that the boundary between the *Pseudoschwagerina* zone and the Artinskian was not a time boundary, but between two facies. Recent Russian work also advocates the placing of the boundary at the base of the *Pseudoschwagerina* zone (Sakmarian).

Investigation of the Carboniferous and Permian strata of North America indicates that the majority opinion has favoured, since the earliest work, the placing of the boundary at the base of *Pseudoschwagerina* zone—that is, at the base of the Wolfcamp series in Texas and the Big Blue series in Northern Mid-Continent. Early determination was based primarily on palæontological evidence, but recent work has shown the existence of a large physical break at the base of the Wolfcamp deposits.

The Sakmarian of Russia now placed in the Carboniferous is regarded as the equivalent of the Lower Permian Wolfcamp. In Europe also the line at the base of the Rotliegende (Autunian), lowermost Permian, is not as high as the top of the *Pseudoschwagerina* zone. Although some Russian geologists regard the boundary as the base of the zone of *Pseudoschwagerina*, opinion is very divided. Evidence from North America, West Europe, and many other parts of the world makes revision of the boundary in Russia to include correlative beds in the Permian extremely desirable. The conclusion reached and suggestion given in the paper is that the revision of the lower Permian boundary in the type area would accord best with palæontological and stratigraphical relationships in different parts of the world.

A bibliography of nearly 250 entries is given. G. S. S.

953.* Classification of Permian Rocks. C. A. Tomlinson and Others. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 337–358.—This is a report of the Association's Sub-committee appointed "to prepare a digest and recommendations for the classification and nomenclature of Permian rocks of the United States."

Among the various recommendations made are: (1) that the Permian rocks of the world should be recognized as an independent geological system; (2) that a standard reference section for America is desirable, and therefore the Permian of the Delaware Basin in West Texas and in South-East New Mexico should be utilized as such a standard; (3) that the zone *Pseudoschwagerina* and *Properrinites* be recognized as comprising the lowest part of the Permian System; (4) that the disconformity which nearly everywhere separates the Permian in North America from the Triassic be recognized as the upper boundary of the system; (5) that the Permian of North America be divided into the following series: Wolfcamp, Leonard, Guadalupe, and Ochoa.

In addition, the problems of defining geological systems, together with their relation to stratigraphical principles, are reviewed. G. S. S.

954.* South–North Cross-Section from Pecos County through Ector County, Texas, to Roosevelt County, New Mexico. W. C. Fritz and J. FitzGerald, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 15–28.—In the preparation of this section—drawn from south to north along the eastern side of the Central Basin platform—thirty-eight sample logs are used.

Pre-Cambrian and *Cambrian*.—Although there is little evidence of these systems in Crane County, both are thought to be present. Other formations which are shown in the section are:—

Ordovician is represented by the Ellenburger dolomite and the overlying Simpson formation. The former appears on the section in the southern portion in Pecos and Crane Counties, and represents the Lower Ordovician and possibly the Upper Cambrian. The Simpson is very similar lithologically to that usually described in Oklahoma.

The *Silurian–Devonian* systems are represented by a limestone tentatively called Fusselman, which appears only in Crane County.

The *Permian* occupies a larger interval than the total of all other ages on the section. Approximately 6480 ft. of deposits are recorded from one well, the base of the system not being reached. The system is divided into seven parts, which, in ascending order, are: Abo, Yeso, San Andres, Whitehorse, Upper Castile, Rustler, and post-Rustler.

The San Andres group extends the full length of the section, ranging in thickness from 1300 to 1700 ft. In the southern part a crystalline dolomite predominates, which grades northward into an evaporite sequence—the upper part mainly salt and anhydrite, the lower retaining some of the characteristic crystalline dolomite. Most of the oil produced in Ector and in five other counties in Texas, as well as from the Hobbs, Vacuum, and Lovington pools in Lea County, New Mexico, is from sediments of San Andres age.

The Whitehorse group unconformably overlies the San Andres and has a thickness varying from 1300 to 1650 ft. In the West Texas–New Mexico Permian Basin the Whitehorse is divided into five formations. Most of the oil produced from the Central Basin platform comes from sediments of the Whitehorse sea.

The section passes through most of the Upper Castile Basin and shows its northern limit. The Upper Castile formation itself is mainly salt, and unconformably overlies the Whitehorse. No economic production of oil or gas is known from deposits of Upper Castile age, although non-inflammable gas has been obtained from the Cowden anhydrite member over structurally high areas in Central Gaines County, Texas.

G. S. S.

955.* South–North Cross-section from Pecos County through Winkler County, Texas, to Roosevelt County, New Mexico. E. H. Woods. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 29–36.—This section extends 260 miles northward along the western side of the Central Basin platform; thirty sample logs are used.

Pre-Cambrian and Ordovician sediments are found in the south in Pecos County. The Permian is the only other Palæozoic formation that occurs, the lowest beds of which (the Yeso) are found in both the north and south. Above the Yeso is the Glorieta, the basal sandstone of the San Andres series; these are brown dolomites grading north into interbedded anhydrite, salt, and dolomite. The Whitehorse group

overlies the San Andres. The Grayburg, the lowest member of the Whitehorse, occurs in four wells, and the Yates Sand, an upper bed, is very widespread. All oil and gas production north of Pecos County is from Whitehorse dolomite and sands below the top of the Yates.

The Upper Castile salt and anhydrite are best developed in the centre of the section, whilst the Rustler which overlies them unconformably consists of porous dolomite and salt. The post-Rustler consists mainly of red shales and sands, and includes the Dewey Lake series. Above come the Triassic Tecovas beds. Post-Cretaceous silt and caliche rest on the Triassic and Permian.

These data illustrate the south-westerly retreat of the Permian sea and the corresponding southward shift of the conditions of salinity. G. S. S.

956.* Geologic Section from Fisher County through Andrews County, Texas, to Eddy County, New Mexico. R. I. Dickey. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 37–51.—This section correlates outcrops on the east and west sides of the Permian Basin, especially those of the Whitehorse group; forty-two logs were used.

Sediments range from Upper Cambrian to Quaternary, but detailed discussion is limited to the Upper Permian, into which nearly all the wells of the Western Texas basin are drilled. On the eastern side Pennsylvanian occurs, the division between it and the Permian being taken at the appearance of the fusulinid *Schwagerina*.

The Lower Permian Clear Fork group consists in the east of shale and evaporites, but grades west to dolomite. A subsequent elevation occurred, and much clastic material is present in the overlying San Andres beds, which are the so-called "Blaine of Texas."

The Whitehorse consists of five formations—the Grayburg, Queen, Seven Rivers, Yates, and Tansill—which can be recognized by their contrasting lithology. The lowest beds, of great economic importance, are here named Grayburg; they are traceable from west to east across the basin, and unconformably overlie the San Andres. The Yates sand varies greatly in thickness, but is widespread in occurrence, and hence is used as a marker in mapping the sub-surface structure.

Overlying unconformable Upper Castile salt is thickest in the Midland Basin, whilst above it is the Rustler, representing the last marine invasion. The top is an erosion surface on which the Dewey Lake sands were deposited. Triassic and post-Triassic beds in part overlie the Dewey series. G. S. S.

957.* Stratigraphy, Eastern Midland Basin, Texas. L. R. Page and J. E. Adams. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 52–64.—The Midland Basin is one of the three major structural features of the South Permian Basin, and has a regional westerly dip on its eastern side.

Thick series of red sandstones, clays, salt, and silts, nearly all of Permian age, have been recognized by surface and sub-surface methods. These formations were laid down in a restricted sea which retreated southward in Permian times; gradations from nearshore clastics to gypsum and to marine limestones and dolomites are also recognized; the upper beds belong only to the onshore and intermediate zones. The Dewey Lake, which is described, is at the top of the Permian, and represents the final retreat of the sea and the filling of the basin with red sands.

The basal Clear Fork group consists largely of reddish shale with seams of white gypsum, with dolomite predominating in the west. The San Andres group above in the east is made up mainly of clastics, whilst traced westwards they are replaced by dolomite. An angular unconformity separates the San Andres from the Whitehorse group, an outcrop characterized by fine-grained red sandstone with frosted quartz grains in all but the lowest formation. The Upper Permian group, separated from the Whitehorse by a time break, is a thick series of saline deposits. The Upper Castile Salt is the main salt series of the Southern Basin, and is succeeded conformably by the uppermost Permian Sands of the Dewey Lake formation.

The Dickum group, of Triassic age, is composed of red terrestrial deposits, and include the Tecovas silt and the upper Santa Rosa and Chinle formations.

Cretaceous beds, where present, consist of a basement sand probably of Paluxy age, and rest unconformably on the Permian and Triassic. G. S. S.

958.* Structural Development, Yates Area, Texas. P. B. King. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 134–142.—The surface dome, near Iraan in eastern Pecos

County, forms a well-marked closed structure in the Permian Basin. This paper, accompanied by sections, gives a comprehensive account of its structural development, together with a brief stratigraphical summary.

The structural development of the Yates area was initiated in beds older than any so far penetrated in the dome, which was overlain by the Whitehorse and Castile Salt formations.

The early Cretaceous period saw great solution and slumping of these salt deposits, and produced a solution syncline over the crest of the Yates dome which became filled with a plug of non-marine clastics. Slight warping in late Tertiary or Pleistocene times again exposed the salt to solution, and slumping of the unsupported sediments around the plug developed the ring syncline responsible for the present surface. This Cretaceous structure overlying arched Permian limestone was therefore developed by salt solution rather than by folding, a solution which occurred in two stages.

G. S. S.

959.* Palæozoic Stratigraphy of Franklin Mountains, West Texas. L. A. Nelson. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 157–172.—The area described in this paper lies within 104° 30′ and 109° W. longitude and 31° and 34° N. latitude, and includes the cities of El Paso and Silver City. Lying within West Texas and South New Mexico, it offers a Palæozoic section from the Pre-Cambrian to the Permian. The mountain ranges have mainly a parallel north to south trend, and enclose basins of unconsolidated deposits characteristic of the Basin-and-Range structural type. The Franklin Mountains rise abruptly on their eastern side from the level of the bolson.

Palæozoic rocks approximate to 8000 ft. in thickness; each formation is described with accompanying stratigraphical diagrams to show the succession and location.

Pre-Cambrian is everywhere the basal formation except in the Hueco Mountains. In the Franklin Mountains a newly-named granite, the Red Bluff, forms part of this base. The oldest known Palæozoic formation is the Bliss Sandstone, here assigned to the Upper Cambrian; absent in the Oscura Mountains in the north, this deposit appears in the south and rapidly thickens. The Ordovician is represented by the El Paso Limestone (1000 ft.) and the Montoya Limestone. The massive dolomitic limestone of the Middle Silurian, the Fusselman Limestone, occurs in the Franklin Mountains, whilst the Middle and Upper Devonian are found in the western part.

Pennsylvanian, here known as the Magdalena formation, is described in detail. Consisting of 1600 ft. of thinly bedded dark grey limestone, it has been divided into three zones: the Bishop's Cap, Berino, and the La Tuna. The characteristic lithology and fauna of these zones are given.

The Permian, in the Franklin Mountains, is represented by the Hueco sediments (650 ft.). They are fine-grained light-coloured limestones, and are separated from the Magdalena by alluvial deposits. This formation is overlain in most of the area by the Comanche.

G. S. S.

960.* Correlation of Pennsylvanian Rocks of New Mexico. C. E. Needham. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 173–179.—The Pennsylvanian rocks of New Mexico, which consist of 1500–1800 ft. of sediments, are known as the Magdalena Formation. They are divided into two lithological types, a lower (600–700 ft.) of sandstones, shales, and thin limestones, and an upper (800–1000 ft.) mainly of limestone with interbedded sandstones and shales.

These sediments are probably of marine origin, and in correlation with other regions chief reliance is placed on their fossil content. Of the large fauna preserved, those of the brachiopods and fusulinids have been used as a basis for regional correlation.

The lowest Pennsylvanian in New Mexico, up to 700 ft., lies below the *Wedekindllina* and *Fusulina* zone, and belongs to that of the *Fusulinella*. It is probably correlative with the Lower Cherokee and Lower Atoka. Above this, the *Wedekindllina* and *Fusilina* occur, and the series can be correlated with the Upper Cherokee and Upper Atoka. These equivalents of the Des Moines beds are recognized in New Mexico, where they attain a maximum thickness of 1000 ft.

Beds of Kansas City and Lansing age in the Missouri series are characterized in New Mexico by the occurrence of *Triticites nebraskensis*, *Neospirifer latus* and *Echinoconchus semipunctatus*. *Triticites* and various brachiopods in the beds above belong to the Lower and Middle Virgil and Lower Cisco age.

The highest Pennsylvanian beds contain *Triticites ventricosus*, and are considered to be Lower Wabaunsee in age. They are well developed in the Sacramento Mountains; elsewhere they are thinner due to the Pennsylvanian–Permian unconformity, a break which is known to be of small magnitude. G. S. S.

961.* Upper Palæozoic Section of Chinati Mountains, Presidio County, Texas. J. W. Skinner. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 180–188.—Upper Palæozoic sediments outcrop in four large areas along the periphery of the Chinati uplift. J. A. Udden, in 1904, gave the name Chinati series to these sediments of the Shafter area; he recognized three formational divisions: the Cieneguita (1000 ft.), the Alta (3500 ft.), and the Cibolo (1400 ft.). He concluded that the Cieneguita and Alta were of Pennsylvanian age, and that the Cibolo might be Permian. Later writers assigned the entire Chinati series to the Permian.

This paper deals with areas visited to the north-west and west of Shafter. From both lithological and faunal characteristics the Chinati Mountain Palæozoic sections appear to consist of a sequence of Pennsylvanian beds and a nearly complete Glass Mountain Permian section. Udden's conclusions were therefore nearly correct, later confusion having arisen owing to lithological resemblances in the Chinati and Pennsylvanian formations. G. S. S.

962.* Morrow Group of Adair County, Oklahoma. C. A. Moore. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 409–434.—This paper is the result of field work and laboratory studies on the rocks of the Morrow group which lie at the base of the Pennsylvanian system. The beds immediately above and below the Morrow are also described.

The Pitkin formation (Chester group), which forms the top of the Mississippian, underlies the Morrow disconformably. It is a limestone, but argillaceous and granular lithologies are also recognized.

In all sections the basal formation of the Morrow (the Hale) rests on eroded Pitkin limestone, and generally there is a phosphatic conglomeratic bed at its base. The Hale is variable lithologically, and it is difficult to interpret the relationships of adjacent sections. It is mainly calcareous sandstone, and is distinguished from the overlying Brentwood limestone by its insoluble residues. The Hale–Brentwood contact is poorly exposed, and is represented by a change in lithological character and residues.

The Bloyd formation, above the Hale, consists of two limestone members, the Brentwood and Kessler, which are separated by dark carbonaceous shale. The Brentwood contains thin shale bands, and in parts of the area cannot be separated from the overlying shale. The Kessler is cut out by the pre-Atoka erosion in the western half of the county. It is distinguished from the Brentwood by its higher percentage of insoluble residue.

There is a disconformable contact between the Bloyd and the Atoka sandstone and shale; this is the lowest formation of the Des Moines group, and nearly everywhere the contact is masked. Numerous sections and photographs accompany the paper. G. S. S.

963.* Subsurface Miocene of Southern Louisiana. A. C. Elisor. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 435–475.—These Miocene sediments lie in an area south of a line drawn from the southern part of Beauregard Parish to the southern part of St. Tammany Parish. The western boundary is formed by the Sabine River, and the eastern limit by the Mississippi River.

A variation in depositional conditions is shown by the sediments, and a transition occurs from a brackish-water facies in the west to a marine facies in the east. The two provinces are roughly divided by the Atchafalaya River.

In the eastern province, the following four zones (in descending order) are recognized: the *Rangia microjohnsoni* zone, the *Uvigerina lirettensis*, the *Operculinoides*, and the *Planulina harangensis* zone; the position of the last zone is in doubt.

The western province has the *Rangia microjohnsoni* and the *Potamides matsoni* zones. It also includes a series of undifferentiated sands and shales which contain a brackish-water fauna and are probably the equivalent of part of the *Uvigerina lirettensis* and *Operculinoides* zones.

All these palæontological zones are described; they range in thickness from 500 to 600 ft. in the case of the *Potamides*, to more than 2590 ft. in that of the *Uvigerina* zone. The *Planulina harangensis* occurs below the *Uvigerina lirettensis* zone; no well has yet penetrated beyond it, and the correct correlation is unknown. It is considered by some palæontologists to be Oligocene in age because certain of its species occur in this formation.

Eight strike sections are also described in detail and are shown graphically. In addition, a locality map is furnished, together with six full-size plates illustrating the fossils described. G. S. S.

964.* Permian in Parts of Rocky Mountain and Colorado Plateau Regions. A. A. Baker and J. S. Williams. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 617–635.—Recent work in the South Wasatch Mountains in North-Central Utah has revealed the presence of a thick sequence of Permian rocks that may become a standard section of the Western United States. Cross-sections and a composite correlation diagram of the whole area accompany the paper.

In the Colorado plateau the Permian is characterized by shifting conditions of deposition and an intermingling of sediments derived from different sources. Except for the Rico formation and the top Kaibab limestone, all the beds are of continental facies. In the Mineral Mountains, Utah, similar stratigraphical relationships are seen; the Kaibab limestone thins eastward and is underlain by a quartzite, probably of Permian age.

The Triassic Woodside Shale overlies the Permian in the southern Wasatch Mountains, where the upper part consists of the Park City formation. The latter is mainly limestone, but its middle shale member contains the Phosphoria fauna. At its type locality the lower part of the Park City formation has long been considered to be Pennsylvanian in age, but the writers suggest that this may need correction, as Lower Park City beds have yielded Permian fossils. Below the Park City in the southern Wasatch are the Diamond Creek Sandstone and the Kirkman Limestone, both tentatively assigned to the Permian; beds somewhat below the top of the Oquirrh formation, which lies under the Kirkman, may form the Pennsylvanian Permian boundary.

In North Utah and South Idaho, the Upper Park City is equivalent to the Rex chert member of the Phosphoria formation; both are overlain by red Triassic shale. The type locality of the Phosphoria occurs at Phosphoria Gulch, Idaho, where it forms 900 ft. of chert and phosphatic shale.

There is a general eastward change in the Permian rocks which is characteristic of the whole area. Fossiliferous marine beds occur in the west, and grade eastward to sparsely or non-fossiliferous red mudstones, grits, and conglomerates.

G. S. S.

965.* Possibilities of Heavy-Mineral Correlation of Some Permian Sedimentary Rocks, New South Wales. D. Carroll. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 636–648.—This paper gives the results of a mineralogical examination of six core samples from Permian sediments at Kulnura, N.S.W. It was carried out with a view to fixing the position of a particular bed of grit or fine conglomerate, 30 ft. in thickness.

The heavy minerals obtained were divided into two groups, detrital and authigenic; these are described, and the percentage composition of the residues indicated showed that there were well-marked mineralogical variations. The average type of mineral percentages obtained were, however, not satisfactory as a basis for comparison and contrast, since so few specimens were used and because of the great distance of the bore-site from outcropping Permian beds. Similar heavy minerals to those obtained occur also in other Permian and Triassic rocks of the Hunter River district, indicating continuous sedimentation over a wide area. Although it is considered unwise to draw conclusions from so few specimens, evidence seems to show that Kulnura grit is part of the upper marine series (Upper Permian), probably the Muree stage.

The need for examining a large number of specimens of all sediments and an investigation of local variations is stressed by the writer as an essential to correlation problems of this nature. G. S. S.

966.* Petrology of Whittier Conglomerates, Southern California. G. J. Bellemin. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 649–671.—The Whittier conglomerates are a

series of Pliocene and Miocene conglomerate lenses which occur in the north-west part of the Puente Hills.

The chief rocks making up the conglomerates are: granite (21 per cent.), biotite gneiss (16 per cent.), and smaller amounts of pegmatites, aplites, and dacite. The granite is termed the "Conglomerate Granite," and has myrmekitic intergrowths of quartz and felspar. The gneiss varies in texture from lenticular to banded types, with quartz, orthoclase, and biotite as its principal minerals. The conglomerate rock-assemblage is typically felsic; plagioclase is not common, and hornblende is very rare.

Possible source areas for the conglomerate are considered to be from the north or east. The eastern area, especially the Perris Block, consists largely of igneous rocks rich in plagioclase, abundant hornblende, and biotite. Metamorphic rocks also occur, though they are not so common, quartz–orthoclase–biotite gneiss being relatively rare. The northern area, the San Gabriel Mountains, consists almost entirely of igneous and metamorphic rocks, the former including granites, quartz monzonites, and diorites. The "Conglomerate Granite" is identical with granite from the Mount Waterman region in the San Gabriel Mountains.

From the rock correlations, a general similarity to the San Gabriel Mountains and a dissimilarity to the Perris Block region, it would seem that strong evidence points to the fact that the San Gabriel Mountains are an important, and possibly the principal, source of the Whittier conglomerates. Thus, also, it is likely that there existed during late Miocene and early Pliocene times a mountain mass of approximately the same composition and at about the same place as the present San Gabriel Mountains.

G. S. S.

967.* Deposition of Lissie and Beaumont Formations of Gulf Coast of Texas. R. J. Metcalf. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 693–700.—The Lissie and Beaumont formations are an integral part of a single cycle of sedimentation which began with the rejuvenation of coastal plain streams and the deposition of the coarse poorly-sorted Lissie material. Later, finer sediments formed the Beaumont clays and sands.

The Lissie and Beaumont beds are a comparatively thin group, and represent only a very short time interval. The former were laid down on a peneplained surface, and are characterized by gravel, sand, and ferruginous nodules. There was a later period of entrenchment of the major streams, and material from the interior was deposited nearer the coast. The change from Lissie deposition to Beaumont was merely one to finer sediments brought down by the major streams which built up their channels and produced distributaries under a flood-plain environment. A later phase of the Beaumont was produced by gentle subsidence in the coastal area when the rivers built deltas and cut channels across the plain.

The physical evidence left by this sequence of events shows a lack of stability of deposition and the process of re-working the material many times. The study of these conditions may help to give a better understanding of the mode of formation of earlier land deposits in the Gulf Coast area.

G. S. S.

968.* Sparta-Wilcox Trend, Texas and Louisiana. J. D. Todd and F. C. Roper. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 701–715.—The Sparta and Wilcox are Lower Eocene sediments which have come into recent and increasing importance as oil reservoirs. They form a series of sands and shales between − 5000 ft. and − 10,000 ft. contours; at the latter level shale appears and marks the lower productive limit.

Earlier discoveries of oil in these formations led to poor results, but recent statistics show that wells carried to the Sparta and Wilcox have proved productive. Two fields especially are noted: Joe's Lake, Texas, producing from the Wilcox, and Ville Platte, Louisiana, from the Sparta. Both appear to be large, flat structures. A new discovery has occurred at Eola, Louisiana, where the reflection seismograph indicates that it has a similar structure. Core analyses and average porosities of the sands bored are given.

There has been a slow development in these fields, due to the fact that sub-surface structure does not always conform to that at the surface, and that little oil exists above the 5000 ft. level. It is now also realized that many of the flatter traps are preferable because they cover more area and suffer less from faulting. The real

effective exploitation of the trend is therefore just beginning, and it appears likely that the ultimate producing area will rival that in the coastal region.

The paper is illustrated by diagrams, electrical logs, and photomicrographs.

G. S. S.

969.* Results of Recent Field Studies in Osage, Washington, and Nowata Counties, Oklahoma. M. C. Oakes. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 716–730.—Rocks of Pennsylvanian age belonging to the Missouri sub-series occur in the area, and a sufficient number of Kansas units are present in northern Oklahoma to enable definite correlation to be made.

The Missouri is separated from the underlying Des Moines by an unconformity, and is probably similarly overlain by the Virgil. The Missouri has been divided into two groups: Skiatook and Ochelata. The Seminole formation is at the base of the former, while Checkerboard beds, here raised to formation rank, which lie above, consist of alternating limestone and calcareous shale. Erosion probably preceded the deposition of the overlying Coffeyville beds, and the Hogshooter, which succeeds them, can be correlated with the Winterset limestone of Dennis formation in Kansas. The name Hogshooter, in Oklahoma, is preferred to Dennis because of its older usage. Above is the Nellie Bly formation of shales and brown sandstones, and the Dewey limestone, at the top of the Skiatook, is the equivalent of the Drum limestone of Kansas.

The lowest formation of the Ochelata is the Chanute, often resting unconformably on Skiatook beds. The overlying Iola varies in thickness, being greatest to the south and west, and above them lies the Wann formation, a new name given to about 100 ft. of shale. It is succeeded by the Torpedo sandstone and shale, which is unconformably overlain in the north and south by the Birch Creek limestone. The latter is identical with the Panther Creek limestone, and may be equivalent to the Little Kaw limestone of Kansas. Above it lie the Okesa sandstone and shale. The highest beds of the area, the Cheshewalla sandstone, occurring in the north-west, may be above the unconformity which marks the top of the Missouri. G. S. S.

970.* Completions in 1939 Normal. J. McIntyre. *Oil Gas J.*, 25.1.40, **38** (37), 76–77.—In 1939 27,053 wells were completed in U.S.A., 18,453 of which were classified as oil wells and 2031 as gas wells; 6355 were dry holes. No great fields were discovered, but a large number of new fields were found, and much new production was added by discoveries of pay sands in already known fields.

The well data are summarized for 1938 and 1939 by States, and the main features of the developments in the various areas are noted. G. D. H.

971.* Domestic Crude Production in 1939 1,255,783,534 brl. J. McIntyre. *Oil Gas J.*, 25.1.40, **38** (37), 78–79.—The 1939 oil production of the U.S.A. exceeded that of 1938 by 54,900,135 brl. The production of each State and of the major oil fields are tabulated for the years 1930–1939, inclusive. G. D. H.

972.* Gulf Coast Drilling Increases, but Fewer Discoveries in 1939. N. Williams. *Oil Gas J.*, 25.1.40, **38** (37), 88.—During 1939 thirteen new fields were opened in Louisiana and twelve in Texas, whilst new sands were found and important extensions made in many proven fields. Probably the most outstanding development was the extension of the Tertiary Wilcox play into coastal Louisiana by the discovery of the Eola field. Exploration round the flanks of known salt domes has added several million barrels of new reserves. The other important developments are noted, and the daily average and monthly production are tabulated for the fields. The wells drilled in 1939, the results, and the new discoveries are listed. G. D. H.

973.* Mississippi and Arkansas Find New Sources of Oil Production. G. Weber. *Oil Gas J.*, 25.1.40, **38** (37), 97.—Mississippi's first oilfield was brought in in 1939. In Arkansas two Smackover lime fields were discovered (Big Creek and Dorcheat). There was mild development at Lewisville and the high-pressure gas-condensate fields in North Louisiana were further developed.

The daily and monthly average productions are given for the fields of Arkansas, North Louisiana, East Texas border, and Mississippi, and the results of drilling in 1939 are summarized. G. D. H.

974.* Cement, St. Louis and Creek County Pools Set Oklahoma Pace. D. Dalrymple. *Oil Gas J.*, 25.1.40, **38** (37), 104.—Almost without exception wildcatting results in Oklahoma in 1939 were disappointing, but there was a revival of operations in several old producing areas. The main developments are noted. The outstanding wildcat opened the Hobart pool at 1049–1055 ft. in the Viola. Hunton lime production has been found in the old Milroy field, and Viola production at Chism.

The daily average and monthly productions of the various Oklahoma fields are given, and the discoveries are listed. G. D. H.

975.* Despite Proration Canada Established Another High. V. Lauriston. *Oil Gas J.*, 25.1.40, **38** (37), 122.—The Canadian output in 1939 was 7,743,313 brl., against 6,946,479 brl. in 1938. Of the four productive regions, New Brunswick alone showed a decline. The volumes of gas marketed increased in all areas. In Alberta, Turner Valley showed an increased oil production in spite of proration, but the small outlying pools declined in output, although some production was obtained from new wells in the Del Bonita area, at Steveville, and at Lloydminster. A new gas-field was opened at Malahide, Ontario. G. D. H.

976.* Many New Pools Found in Kansas; Proven Areas Extended. D. Dalrymple. *Oil Gas J.*, 25.1.40, **38** (37), 126.—Field activity in Kansas was at its lowest since 1935, but there was an improvement late in 1939. Wildcatters opened some forty new oil-pools and several gas-pools, and extended many old areas. There were extensions at Silica, Trapp, Bemis, South Burnett, Bloomer, Wherry, Geneseo, and Chase. Late in the year oil was found near Falls City, South-East Nebraska, in the Forest City basin. The Kansas oil and gas discoveries of 1939 are listed, together with the number of wells, producing formation, depth, and initial production. A summary is given of the wells and wildcats, and the daily average and monthly productions are tabulated for the various fields. G. D. H.

977.* Production Outside the U.S. Establishes a New Record. H. S. Norman. *Oil Gas J.*, 25.1.40, **38** (37), 81.—In 1939 the extra-U.S.A. oil production of 814,028,960 brl. was 4% higher than in 1938. Venezuela had a 9·5% rise, which is not a true measure of its possibilities. Russia's increase was 2%. New production records were established in Trinidad, Colombia, and Argentina. The outputs of Mexico and Rumania fell. Saudi Arabia has risen to importance as an oil-producer, and the Ras Gharib field has boosted Egypt's output. G. D. H.

978.* New Mexico Led Development in Rocky Mountain District. T. R. Ingram. *Oil Gas J.*, 25.1.40, **38** (37), 148.—During 1939 seven new producing areas were opened in New Mexico. Loco Hills is outstanding, and gives oil from a Permian sand at 2874 ft. The new discoveries of New Mexico are listed, together with the depths and producing formations.

Activity in Colorado was sub-normal. Deepening a Fort Collins well revealed oil saturation in the Dakota and commercial production was obtained. One gas-find was made in Wyoming in addition to the discovery of deeper pays and the extension of old fields. The gas was found at Horne Valley. A small oil discovery was made in the Madison in Montana, west of Pondera, and extensions were opened in some fields.

The wells drilled in these States in 1939 are listed, and the daily average and monthly productions of the various fields are tabulated. G. D. H.

979.* Twenty-seven Pools Discovered, Four Extended in Illinois. Anon. *Oil Gas J.*, 25.1.40, **38** (37), 157.—The most outstanding feature of 1939 was the rise in output of the Salem field. Six pay horizons were found in East Illinois, and Cypress production was obtained in the central-basin fields. Devonian production was proved at Salem, Sandoval, Sorento, Bartelso, and Centralia. In the south-eastern part of the State the discovery of oil in Gallatin County extended the productive limits of the Illinois basin considerably. Data about the discovery wells of the new field extensions are given, together with the daily average and monthly productions of all the fields and a summary of the wells completed in 1939. G. D. H.

980.* Nebraska Discovery is Feature of Forest City Play. D. Dalrymple. *Oil Gas J.*, 25.1.40, **38** (37), 160.—Nebraska's first oil-pool came in in 1939, yielding oil from the Hunton lime in the hitherto unproductive Forest City basin. This basin has been tested in Missouri, Iowa, Kansas, and Nebraska. Showings of oil were found in some of the Missouri wells. Oil and gas were found in the Gardner district of Johnson County, Kansas, in the Squirrel and Bartlesville sands. The results of drilling in Missouri and Nebraska are tabulated. G. D. H.

981.* California adds Four Oil-Fields in 1939; Extensions of Pools. L. P. Stockman. *Oil Gas J.*, 25.1.40, **38** (37), 163–166.—New fields were opened at North-East Coalinga (Fresno County), and Arvin, Paloma, and Strand (Kern County). Arvin gives oil from a fault-trap in the Lower Pliocene. At North-East Coalinga oil is obtained from the Eocene on a broad south-east-plunging nose. The Strand oil is from the Upper Miocene. Seismic work showed a structure at Paloma, and oil was found at a depth of 10,178 ft.

A number of old fields were extended or had deeper producing horizons penetrated. Tables give the daily average and monthly productions of all the fields, and the results of the wells drilled during 1939.

A new method of curtailment was introduced in 1939. G. D. H.

982.* Thirty-five New Oil- and Gas-Fields Opened in South-West Texas. F. L. Singleton. *Oil Gas J.*, 25.1.40, **38** (37), 168.—In addition to new fields there were many important extensions and new sand discoveries in 1939. Probably the outstanding development was the extension of the Frio-Vicksburg play through Jim Wells, Brooks, Hidalgo, and Starr Counties, and the expansion of the Tertiary Wilcox trend play from the Upper Gulf Coast district through the Pettus trend as far south as Webb County. Twenty-four new oil- and gas-pools were found in the Corpus Christi district. In Victoria County there were shallow Catahoula discoveries (Cologne and Victoria). The Rincon field, a former distillate-producer, gave oil.

The results of wells drilled in 1939 are summarized, and tables give the daily average and monthly productions for all the fields. G. D. H.

983.* North and Central Texas Areas had One of Busiest Years. D. H. Stormont. *Oil Gas J.*, 25.1.40, **38** (37), 174.—In 1939 thirty-one new fields were found, in addition to new oil horizons in old fields. Two Ordovician fields were discovered in Cooke County, and two Strawn fields. Strawn, Granite Wash, and Bend lime production was obtained in new discoveries in Montague County. Pools were opened in the Bend and Strawn series of Stephens County. There was much wildcat activity on the Palo Pinto lime trend extending across Jones County and north-west Shackleford County.

The discoveries are tabulated, together with the depths, production, and oil-bearing formations, and the daily average and monthly outputs of all the fields are tabulated. G. D. H.

984.* East Texas Wildcatting in 1939 had no Important Results. R. M. Sanford. *Oil Gas J.*, 25.1.40, **38** (37), 182.—Three new pools were opened in Woodbine sand areas (Henderson, Leon, and Navarro Counties); a shallow Strawn pool in Denton County and a Glen Rose distillate pool in Limestone County. A deep lower Marine Trinity wildcat campaign spread over most of the area. The discoveries are listed, together with depths, outputs, and oil horizons.

The East Texas field is now on the decline, and plugging of depleted wells far exceeds new completions. The results of drilling in East Texas in 1939 are summarized, and the daily average and monthly productions of the fields are given. G. D. H.

985.* Michigan Crude Production Rose to an All-Time High in 1939. O. C. Pressprich. *Oil Gas J.*, 25.1.40, **38** (37), 184.—In 1939 the Michigan production was 23,566,406 brl. 20,338,000 brl. of reserves were discovered. Nine fields were found and seven were extended. The outstanding strike was the Walker–Wyoming–Tallmadge area, which gives oil from the Traverse lime. There were revivals at Salem and New Salem, with continued success in the Traverse. Some seismic work was started late in the year.

The new discoveries, depths, productions, etc., are listed, and tables give summaries of the completions and daily average and monthly productions for all the fields. G. D. H.

986.* New Pools and Deep Pays in West Texas; Quiet in Panhandle. D. H. Stormont. *Oil Gas J.*, 25.1.40, **38** (37), 191.—Nine new producing areas resulted from wildcatting in 1939. At Cedar Creek production is in the San Andres (Perm.) lime. The Apco pool in the Ellenburger lime covers 2500 acres. In Ector County a new and deeper lime-pay was found in the Lower Permian. The Yates is productive at Fromme. Great activity led to the uniting of the Wasson and Bennett fields. There were no discoveries in the Panhandle.

A table shows the discoveries, their productions, depths, etc., and the results of drilling are summarized. The daily average and monthly productions of the fields are tabulated. G. D. H.

987.* Eastern and Western Kentucky, Indiana, Ohio, and Eastern Fields. Anon. *Oil Gas J.*, 25.1.40, **38** (37), 196.—Tables summarize the results of drilling during 1939 in Eastern and Western Kentucky, Central and South-Eastern Ohio, the Lima field, Indiana, and the Eastern fields (Pennsylvania, etc.). G. D. H.

988. Illinois Discoveries not Equalling Drop. H. F. Simons. *Oil Gas J.*, 23.5.40, **39** (2), 31.—The results of recent drilling in Illinois are not sufficient to offset the decline in output from the Devonian lime of the Salem pool. In the renewed efforts this year there have been fourteen discoveries, including extensions and new pay horizons. Nearly all are in the south-east of the State.

The most important pool found is Irons, in White County. The oil is at a depth of about 2500 ft. in the Hardingsburg sand of the Chester series. The reserves are estimated to be 1,000,000 brl.

The Albion pool, of Edwards County, gives McClosky and Waltersburg production, and the Bridgeport sand is reported to be oil-saturated. McClosky production has been found in Jasper County and Cypress production in Hamilton County.

G. D. H.

989.* U.S.S.R.; Russian Oil Survey. J. Wegrin. *World Petrol.*, April 1939, **10** (4), 62; May 1939, **10** (5), 61; June 1939, **10** (6), 119; July 1939, **10** (7), 52; Aug. 1939, **10** (8), 62; Sept. 1939, **10** (9), 54.—The Caucasian oilfields give 91% of the entire Russian output, 75% being from Baku, 10% from Grozny, and 6% from Maikop. Ishimbayevo gives 3%. The aggregate refining capacity is 1,157,000 brl./day, with 89% of it in the Caucasian area. The home consumption is about 23,850,000 tons/annum.

The fields of the Baku region are listed. They obtain oil from Tertiary beds which consist of clays and sandstones with important æolian sands. There are many oil seeps and evidences of petroleum such as mud volcanoes. Many of the fields have 18–20 producing sands, which are often lenticular.

Of the 7500–8000 wells, 1200–1500 are shut down for one reason or another. About 67% of them are under mechanical operation, whilst only 400 flow. Outputs range from 2 to 80 tons/day. The upper sands are now exhausted, and wells are now being taken to 8000–10,000 ft., with the average depth 2500–3500 ft. Well spacing is 1–4 hectares. Electricity is widely used for drilling. Two 600-ml. pipe-lines run from Baku to Batum.

There are about 200 petroliferous regions in Circasia, of which Grozny is the oldest and most important. The original prolific but short-lived wells were opened in 1893 on an anticline. In 1913 the new Grozny fields came into operation, and extended to Vosnessenski. The Grozny fields are in Tertiary beds, which consist of shales, sandy clays, limestones, and dolomites. There are several petroliferous horizons, and there are productive anticlines at Alkhazovo, Eldarovo, Molgabek, Adjurt, and Vosnessenski.

North of the Caucasus there is commercial oil in sands of the Mediterranean and Maikop beds. The Lower Maikop beds are oil-bearing at Maikop, whilst in Daghestan, at Benoi, Berekei, and Kosh Mensil, they yield gas. Gorski Mountain and Molgabek are complicated structures the development of which is retarded by their isolation.

Up to 1937, 80,000,000 tons of oil had been recovered from the Grozny group of fields, 95% being from Old and New Grozny. The crude is paraffin-base with the present wells 5000–6000 ft. deep. 23% of the wells flow, and they drain 1–4 hectares each. A 372-ml. pipe-line runs through Maikop to Tuapas.

There was primitive production at Maikop in 1821, but modern development dates

from 1907. The Maikop beds are productive, and oil has also been found in the Mesozoic. Kutaiski is a monocline dipping at 30°, and other favourable areas are under study.

The Georgian fields south of the Caucasus give about 335,000 tons of oil/year. Naftalan and Pirsagat are the most important zones. North of the Caucasus, in Daghestan, are a number of small fields of which the structures are complex. High hopes are held of this district, which lies on the Caspian coast. The Kuban–Black Sea area, which gives about 20,000 tons of oil/year, is being tested.

The Emba area is said to have large oil reserves and 1200 salt domes. The oil is believed to be in Jurassic beds. The wells are deeper than is general in the other Soviet fields. Oil reserves are estimated to be far in excess of 40,000,000 tons.

The main development of the Ural–Volga region dates from about 1929. Most of the oil found is in the Carboniferous, but some is in the Permian. The area is considered to have good prospects, and pipe-lines are to be built with connections to the industrial centres of Siberia. New refineries are to be constructed.

A little oil has been produced in the Ukraine. G. D. H.

990.* Preliminary Report on the Application of the Mass Spectrometer to Problems in the Petroleum Industry. H. Hoover and H. Washburn. *Petrol. Tech.* (*A.I.M.M.E.*), May 1940, Tech. Pub. No. 1205, 1–7.—Work has shown that it is possible to run a qualitative and quantitative analysis of an unknown mixture of hydrocarbon gases with an accuracy better than $\pm$ 5% of each of the various constituents. The method is relatively rapid.

The form and use of the mass spectrometer are briefly described. The instrument is highly sensitive, and a sample of gas as small as a tenth of a cubic millimetre at N.T.P. can be used. Distinction between methane or ethylene and ethane is very easy, even though the former two are 20,000 times as abundant as the latter, and hydrocarbons can be determined in the presence of other gases.

Differences in cracking patterns permit the detection of isomers.

Interesting observations have been made on the distribution and quantities of various hydrocarbons in soil samples, cores, and drilling mud samples. A routine technique has been developed for qualitative and quantitative determinations of the paraffin series, including methane, ethane, propane, butane, pentane, and still heavier members, together with some of their isomers.

The instrument is not portable, but may possibly be suitable for some of the problems in refinery practice. G. D. H.

991.* Deep Venezuelan Producer Larger than First Indicated. Anon. *Oil Wkly*, 13.5.40, **97** (10), 15–18.—El Roble No. 2 has been thoroughly tested in the intervals 9349–9520 ft. The former gave oil at the rate of 1113 brl./day on a $\frac{1}{4}$-in. choke, and the latter 1816 brl./day on a $\frac{1}{2}$-in. choke. An earlier test in the 9620–9647-ft. interval gave oil at the rate of 189 brl./day. This well is about 6 ml. from the Mene Grande pipe-line. Locations have been selected for El Roble No. 3 and El Roble No. 4.

The El Roble structure is large and gives oil from Oligo–Miocene beds. It is a few miles from the San Joaquin field. G. D. H.

Drilling.

992.* Electrical Equipment on Rotary Drilling Rigs. G. R. Prout. *Petrol. Engr*, May 1940, **11** (8), 33.—This long paper discusses two arrangements of equipment which provide easy means of obtaining the advantage of being able to utilize full available engine horse-power under all drilling conditions. In one of these schemes two engines are used, each driving a large and a small generator specially designed for oilfield work. The method of connecting up under various conditions, the characteristics and controls of the generators and motors, the degree of flexibility, and various advantages obtainable are detailed. Advantages are summarized as: (1) Complete manœuverability and flexibility of rig operation are provided under all conditions of drilling or emergency operations. (2) The drilling load is automatically divided between the two or more engines. (3) The maximum output of engines is limited automatically to a safe value by generator design. (4) The power is smoothly and

gradually applied to the load, and high torque at very low speeds is afforded, with consequential avoidance of shock loads. (5) The maximum output of both engines can be fully, easily, and safely used for hoisting service. (6) High empty-hook speed is automatically provided. (7) The mud pump motor will slow down and stall in case of excessive pump pressures due to plugged bit or pipe, probably saving both power and fluid ends of the pump. (8) Pump speed can easily be controlled over a wide range. (9) The engines operate at constant speed regardless of speed-torque requirements of the load. (10) Engine speed can be reduced when drilling conditions do not require full power output of the engines at full speed, and still provide all the rig manœuverability and flexibility of control provided at full speed. (11) Low fuel consumption. (12) Electric energy available for lighting and auxiliary services from exciters, eliminating necessity of running small separate engine-generator for this purpose. (13) Closed cooling-water system can be used with very little make-up water required. (14) Engines and generators can conveniently be situated at any place round the rig.

The more important advantages are illustrated in the case of recovering a stuck pipe by pulling at maximum allowable line load, rotating at creeping speed, and circulating mud simultaneously. The second deepest hole in the world was drilled to a depth of 14,582 ft., using diesel full-electric rig. Details of this rig are included.

Rigs using diesel electric systems but driving the pumps mechanically from the engine are similarly studied. A. H. N.

993.* New Magnetic Method for Orienting Deflecting Tools. Anon. *Petrol. Engr*, May 1940, **11** (8), 48.—The orientation is accomplished by the use of a non-magnetic sub containing two small magnets and provisions for seating a directional magnetic single-shot instrument. Cross-sectional sketch and details are given. A. H. N.

994.* Deepening and Completing a Well in the Lizbon Field, Louisiana, Pt. 4. P. D. Torrey and F. H. Miller. *Petrol. Engr*, May 1940, **11** (8), 103.—The fourth part of this exhaustive paper follows similar lines to the previous three, in that it details, with extensive data, every step undertaken in deepening a certain well. Sizes, weights, loads, and other characteristics of equipment and operations are given.

This part continues the discussion on drilling, mud control, weight on bit, depth measurements, coring, and fishing jobs, and gives suggestions for the prevention of the last operations.

A summary of the drilling procedure is given in order to bring into prominence various important points and suggestions resulting from these studies, in the hope of reducing drilling time on future similar jobs.

This part concludes with completion and sand-testing procedures. Further parts will be published later. A. H. N.

995.* Drilling and Completion Practices Involving Use of Light-Weight Alloy Metal. R. C. Graham. *Petrol. Engr*, May 1940, **11** (8), 121.—The uses of drillable light-weight alloys in multiple-zone production, and in special cases of shooting just below the casing, are detailed and illustrated by sketches and tables. Care is exercised in lowering the pipe in the hole, although it is generally handled as an ordinary pipe, because alloy casing cannot withstand the same vertical column load as steel. It is ideally suited for removal either by the use of a piloted-type five-bladed drag bit or a conventional wall-scraper. Rotary table speeds ranging from 50 to 125 r.p.m., and a bit weight of 2000 lb., have proved most satisfactory, the average rate of removal being 5 ft./hr. This rate of removal has been influenced by cement behind the removable section. Mud screens or some other adequate method must be used for removing the cuttings from the mud.

Reviewing the progress made during the last year by operators in the Illinois Basin in the use of drillable metal, it is observed that twin well drilling for multiple sands has been greatly reduced, with resultant larger profits to the operator owing to a reduction in his investment costs. It has permitted the adequate testing of doubtful formations that were cased-off in testing lower sands. A method of reducing high gas–oil ratios has been made possible by the insertion and supervised removal of drillable metal in casing strings, and, finally, better bottom-hole cement plugs for water shut-offs are more easily obtained. A. H. N.

996.* Latest Developments in Oilfield Equipment Displayed at Petroleum Exposition. Anon. *World Petrol.*, May 1940, **11** (5), 42–87.—This long treatise gives diagrams, photographs, characteristics, and detailed descriptions of oilfield equipment exhibited at Tulsa, Texas. The apparatus described are extremely varied, and range from derricks and drilling equipment to production engineering necessities and accessories. A. H. N.

997.* Effect of Formation Permeability on Plastering Behaviour of Mud. H. T. Byck. *Oil Wkly*, 3.6.40, **97** (13), 19–20; cf. also *Oil Gas J.*, 30.5.40, **39** (3), 50–51. *Paper presented before American Petroleum Institute.* It has frequently been stated that the loss of liquid from drilling mud increases with increased permeability of the formation penetrated. Several recent papers which present a theoretical analysis of the filtration of muds point out that this factor should have little or no influence on the mud plastering. The present paper presents extensive experimental data to check this important point.

The results from experiments with representative muds without chemical or other treatment are found to indicate the same water loss and mud-sheath thickness on cores of widely different permeabilities.

Such results cast grave doubt on the ability to force either cement slurries or whole mud into homogenous formations; and it appears necessary to conclude that the appearance of mud or cement in wells adjacent to the one under consideration can take place only through crevices, channels, fractures, caverns, or similarly large pores. A. H. N.

998.* Drilling Curve Climbs Sharply to Highest Point Since 1920 Peak. L. J. Logan. *Oil Wkly*, 13.5.40, **97** (10), 12–14. Tables and a graph illustrate the statement of the title. A. H. N.

999.* Some of the World's most Difficult Operating Problems. R. W. Harrison and W. F. Knode. *Oil Wkly*, 20.5.40, **97** (9), 48–54. Operations in Turner Valley have presented great difficulties both in drilling and producing operations. The characteristics of this field in Canada are outlined.

An average well costs approximately $160,000 to turn into the tank, mainly due to hard drilling. The time required from spudding to the cementing of the oil string at an average depth of 8000 ft., is from 4 to 5 months, with an additional 2 or 3 weeks to drill the lime section and complete the well. The drilling equipment is described, and the size and characteristics of components are given.

Completion work is similarly described, together with various methods of acidizing and cleaning the wells.

Paraffin accumulation in tubing is a serious problem, requiring constant attention. The greatest difficulty is experienced during the period of low allowables. One effective means of combating this nuisance is to blow the well down through wide-open connections for about an hour, at weekly intervals. Details are given. A. H. N.

1000.* Welding Surface Casing at Oklahoma City. Anon. *Oil Gas J.*, 2.5.40, **38** (51), 37. Substantial savings in the cost of wells at Oklahoma City are being effected by the use of light-weight welded pipe for surface casing. The procedure of setting such casing strings is given. In all cases the strings have had float shoes of the slip type which are welded on to the string. A. H. N.

1001.* Tool-Joint-Wear Data kept on Simplified Records. H. F. Simons. *Oil Gas J.*, 2.5.40, **38** (51), 39.—Practices with regard to tool-joint maintenance and replacements in drilling Illinois wells are given. Average life of drill-pipe in this basin is from 50,000 to 60,000 ft., the tool-joints requiring replacements at least once and sometimes twice during this lifetime. Additional footage may be gained on the last set by having a ring of hard-surfacing material applied on the drill-pipe at the tool-joint shoulder. This treatment cannot be used with new pipes, as replacements of joints would then be very difficult.

A detailed record is kept of the wear of the tool-joints, and an example of such a record is reproduced. The illustration is studied in detail to explain the usefulness of the data recorded. A. H. N.

1002.* Devonian Drilling. H. F. Simons. *Oil Gas J.*, 9.5.40, **38** (52), 74.—Great difficulties are being encountered in drilling for Devonian production in the Illinois basin. The major problem appears to be the prevention of loss of mud into the formation and the sticking of the drill-pipe while coming out of the hole. In the best areas from 5 to 6 tons of aquagel are required for the mud, whilst the worst areas for loss of circulation require from 10 to 12 tons. In addition, considerable quantities of fibred material are used to plug up the pores in the formation, so that a sheath is formed. Details of a method of controlling the mud are given.

Loss of cement in setting casing is a similar problem. Various methods of eliminating this trouble in cementing operations are described. In one method the porous formation is cemented before running-in the casing, using a retainer just above the sand. Another method is to use a multiple-stage cementing tool and a casing shoe. A variation of this is to squeeze the cement through the ports of the cementing tool and use two retainers to localize the cement to the formation by placing them below and above the tool. Details of pressures encountered are given.

Another method is to run the casing in the ordinary manner and cement round the bottom with approximately 300 sacks. After allowing time for the cement to take its initial set, a second batch is forced into the hole behind the pipe through the braden head, the cement being forced downwards to displace the fluid into the formation.

This method is also applied with a variation by other operators. A. H. N.

1003.* Technical Aspects of Carter Pressure Core Barrel. P. Reed. *Oil Gas J.*, 16.5.40, **39** (1), 114.—The significance of data obtainable from using a Carter pressure-core barrel is discussed in detail. The more general applications of pressure cores and pressure-core data are: (1) A more certain determination of reservoir content than is furnished by the conventional non-pressure-type core barrel. (2) Locations of gas caps and determination of content. (3) Studies of oil, gas, and water gradients through a producing zone. (4) Studies in well spacing. (5) Studies of oil remaining in place in depleted fields by drilling and coring intermediate wells. (6) Studies of various methods and rates of production by working on cores while they are under pressure. (7) Studies of contamination of cores. Various other uses are discussed, including the possibility of coring unconsolidated sands.

A new core barrel has recently been completed very similar in design to the original experimental one, except that it is now possible to cut a core 2¾ in. in diameter instead of the original 1¾ in. The length of the core is 8 ft. 6 in. A description and detailed sections and photographs reveal the mechanism employed.

Since drilling fluid has a tendency to precede the drill into formations, special attention has been paid to the prevention of contamination. This meant increasing the size of the core and a study of mud control and treatment. Such studies resulted in designing a high-pressure wall-building tester for muds; the apparatus is described. High-pressure differentials and temperatures are employed to approximate bottom-hole conditions. The rate of water loss is measured at constant pressure differential and temperatures. A. H. N.

1004.* Operating Economics in Lake Centralia–Salem Field, Illinois. T. P. Sanders. *Oil Gas J.*, 23.5.40, **39** (2), 50.—Because of highly competitive drilling in this field, technical advancements in production engineering are mainly ignored. Steps towards economy are, however, constantly being taken.

It has been found that for the U.S.A. as a whole 75% of the total sum expended on the average well throughout its life is spent before any oil is produced. This suggests that development work represents the most advantageous field for economy.

Furthermore, operators found it possible to reduce their development costs for shallow wells from $10,000 to $8,000/well. This fact, however, did not mean a saving of only 20%. The average expected recovery/well was $18,000—*i.e.*, 80% profit on money originally invested. With the new economical development this figure rose to 125%, due to the fact that a million dollars could be spread over a greater number of wells than was possible previously, thus bringing in a 45% greater profit.

The paper details the various steps taken to effect economy in development. Drilling masts were substituted for derricks for wells down to 3400 ft. Loss of circulation was a difficult problem, and methods of solving it were evolved. Use of cement in

one of many methods specially evolved for the field is overcoming this difficulty. Use of fibrous materials with the cement, multiple-stage cementing with or without packers to localize the cement into the porous formation, cementing through the braden head, and variants of these methods are used.

Economies in pumping and other production operations are practised by the use of the correct equipment. A. H. N.

1005.* Difficult Completion Job. J. P. O'Donnell. *Oil Gas J.*, 23.5.40, **39** (2), 68.—The successful completion of a wildcat well which blew open for three weeks before it was brought under control is described. While blowing wild, the well had a flow measured at more than 50 million cu. ft./day. Several factors contributed to make the job of bringing the well under control one of unusual difficulty. Casing had not been run before the well drilled itself in, and highly porous formations, as well as deep-shale gas pockets, carried off mud and cement when attempts were made to kill the well. Either a break in the water string or channelling around the shoe permitted mud and cement to escape also through shallow water sands.

Details of three unsuccessful, and a fourth successful attempt to kill the well are given. Aquagel, fire clay, and Fibretex were used. Mud and cement were pumped in by two separate units. A. H. N.

1006. Patents on Drilling. W. Schwemlein. U.S.P. 2,198,744, 30.4.40. Appl. 24.10.36. Pitman connection.

F. E. Patton. U.S.P. 2,198,836, 30.4.40. Appl. 6.11.37. Surveying instrument for testing the straightness of a vertical member such as a drill-pipe before it enters the hole.

R. L. Waxler. U.S.P. 2,198,849, 30.4.40. Appl. 9.6.38. Drill bit.

H. S. Pierce. U.S.P. 2,199,292, 30.4.40. Appl. 17.11.38. Heavy duty drive chain.

J. F. White. U.S.P. 2,199,298, 30.4.40. Appl. 17.11.38. Fishing tool.

L. F. Athy and H. R. Prescott. U.S.P. 2,199,367, 30.4.40. Appl. 10.8.38. Method of logging bore-holes electrically.

C. M. Anderson. U.S.P. 2,199,582, 7.5.40. Appl. 28.3.38. Reverse clutch and gearing unit.

A. C. Catland. U.S.P. 2,199,692, 7.5.40. Appl. 11.8.37. Demountable blade bit.

A. C. Catland. U.S.P. 2,199,693, 7.5.40. Appl. 18.11.38. Well reamer.

G. R. Huff. U.S.P. 2,199,725, 7.5.40. Appl. 16.3.39. Self-lubricating stuffing-box for oil wells.

F. G. Beckman. U.S.P. 2,199,733, 7.5.40. Appl. 11.5.38. Combination rotary table and pack-off head.

F. G. Beckman. U.S.P. 2,199,734, 7.5.40. Appl. 11.5.38. Portable rotary table.

F. G. Beckman. U.S.P. 2,199,735, 7.5.40. Appl. 29.12.38. Packing gland.

W. V. Bowles. U.S.P. 2,199,738, 7.5.40. Appl. 7.4.39. Tool joint for drill stem.

M. E. Bolles. U.S.P. 2,199,873, 7.5.40. Appl. 3.10.38. Oil well rig on wheels.

E. C. Hamm. U.S.P. 2,199,969, 7.5.40. Appl. 6.3.39. Straight pull tool jar.

D. U. Shaffer, F. D. Hobbs, and E. C. Hamm. U.S.P. 2,199,972, 7.5.40. Appl. 27.5.38. Circumorbital cutting tool.

J. W. McNeil. U.S.P. 2,200,093, 7.5.40. Appl. 18.10.38. Pipe wrench.

T. A. Taylor and C. F. McComas. U.S.P. 2,200,210, 7.5.40. Appl. 28.9.38. Safety device for rotary drilling rigs.

J. W. MacClatchie. U.S.P. 2,200,337, 14.5.40. Appl. 18.12.37. Drill bit.

C. C. Winslow. U.S.P. 2,200,482, 14.5.40. Appl. 13.8.38. Rock bit.

R. L. Kerr. U.S.P. 2,200,505, 14.5.40. Appl. 30.8.38. Locating device for use in bore-holes.

J. B. Newsom. U.S.P. 2,200,516, 14.5.40. Appl. 27.7.37. Drill hole sheave carrier.

M. Schlumberger. U.S.P. 2,200,683, 14.5.40. Appl. 24.1.36. Core taking device.

F. A. Bent, A. G. Loomis, and H. C. Lawton. U.S.P. 2,200,710, 14.5.40. Appl. 19.2.38. Method of sealing water-bearing formations by introducing into formation a water soluble salt of hydrofluosilicic acid and reacting it with an alkali salt to produce a precipitate.

J. E. Hall. U.S.P. 2,200,716, 14.5.40. Appl. 27.6.38. Casing protector applicator tool.

C. L. Henry. U.S.P. 2,200,775, 14.5.40. Appl. 15.8.38. Derrick.

H. T. Ringrose. U.S.P. 2,201,055, 14.5.40. Appl. 27.7.37. Apparatus for indicating the presence of inflammable vapours or gases electrically.

I. C. Bell. U.S.P. 2,201,219, 21.5.40. Appl. 16.10.37. Drill bit.

W. D. Owsley and R. L. Shook. U.S.P. 2,201,299, 21.5.40. Appl. 21.3.38. Multiple stage cementing.

J. F. Shaw. U.S.P. 2,201,379, 21.5.40. Appl. 2.6.39. Drill bit of roller type with side cutters.

C. J. Gallagher. U.S.P. 2,201,434, 21.5.40. Appl. 10.2.40. Fishing tool.

J. A. Zublin. U.S.P. 2,201,569, 21.5.40. Appl. 21.2.38. Compact roller drilling bit.

J. A. Zublin. U.S.P. 2,201,570, 21.5.40. Appl. 3.1.39. Rotary earth boring bit.

T. S. Park. U.S.P. 2,201,673, 21.5.40. Appl. 6.11.37. Rotary drilling machine.

C. A. Doud. U.S.P. 2,201,813, 21.5.40. Appl. 12.2.38. Device for laying pipe at an oil rigging.

D. E. McKee. U.S.P. 2,201,909, 21.5.40. Appl. 19.5.36. Bore-hole inclination transmitter comprising a pendulum and a number of eccentrically spaced contact rings to transmit an impulse when the pendulum contacts any one of them.

A. L. Straub. U.S.P. 2,202,173, 28.5.40. Appl. 29.6.39. Well cementing device.

F. N. Osmun. U.S.P. 2,202,260 and 2,202,261, 28.5.40. Appl. 28.8.39 and 23.8.37 respectively. Safety joint adapted for use in a string of pipe in a well.

C. J. Esseling. U.S.P. 2,202,446, 28.5.40. Appl. 7.11.39. Pipe grip for rotary tables.

G. J. Nash. U.S.P. 2,202,461, 28.5.40. Appl. 1.11.37. Detachable float plug for casings.

C. J. Haynes. U.S.P. 2,202,656, 28.5.40. Appl. 15.7.38. Well-logging electrode.

J. T. Ellis. U.S.P. 2,202,985 and 2,202,986, 4.6.40. Appl. 22.5.39 and 24.7.39 respectively. Pipe cutters.

G. P. Ellis and J. T. Ellis. U.S.P. 2,203,011, 4.6.40. Appl. 8.4.37. Pipe-cutter.

H. E. Grau and R. K. Hertel. U.S.P. 2,203,139, 4.6.40. Appl. 3.12.38. Drilling-hook having a universal joint so that hook can tilt relative to stem.

M. Hokanson. U.S.P. 2,203,216, 4.6.40. Appl. 18.1.39. Drill bit. A. H. N.

Production.

1007.* Portable Laboratories for Core Analysis. D. H. Stormont. *Oil Gas J.*, 2.5.40, **38** (51), 49–50.—Immediate analysis of cores eliminates the time lost in the transportation of such cores and yields more accurate results. A description is given of laboratories on trucks which are completely equipped to analyse cores immediately on removal from the barrel for permeability and porosity values, for fluid index, and for per cent. residual-oil saturation, as well as such items as gas–oil and oil–water contact and gravity of oil.

The procedure followed is detailed. One sample/ft. is usually sufficient, but where sands are extremely variable two samples/ft. are tested. The results of the analysis are available approximately 3 hr. after the core is pulled, which is usually sufficiently rapid to keep up with coring operations.

A typical analysis chart is studied to illustrate the use of the methods. A. H. N.

1008.* Metals in Production. W. L. Nelson. *Oil Gas J.*, 2.5.40, **38** (51), 52.—This is the fourth of a series of articles on the metallic materials that have been recommended by equipment and metal manufacturers for use in producing equipment. A table gives recommended percentage composition, in terms of carbon, manganese, nickel, molybdenum, and "others," the physical properties in terms of yield point, endurance limit in air and in H_2S, and Brinell hardness, as well as notes on heat treatment for metals used in rods and couplings. In all twenty-six metals are thus described.

"Endurance limit" is defined as the maximum load in lb./sq. in. which the material can sustain during a limitless number of load applications or reversals of stress. A table shows a range from 30,000 to 59,000 lb./sq. in. for endurance limit in air, with a corresponding range of 11,000–22,000 in H_2S; the lowest limit in air is, however, not necessarily low in H_2S and *vice versa*. A. H. N.

1009.* Recycling Becomes Important Phase of Oil Operations. E. Kaye. *Oil Gas J.*, 9.5.40, **38** (52), 34.—The quantity of liquid recovered in a recycling plant for producing from distillate fields is very small. Thus, the gas is brought to the surface and run through the plant with a minimum of pressure drop, and the effect of retrograde condensation is achieved as a plant function and is avoided in the reservoir.

At least five variations of extraction methods are in use, each varying from the other by the extent of cooling and circulation of the materials subjected to retrograde condensation.

A great deal remains to be learnt about the behaviour of the dry gas returned to the reservoir after separation of the distillate. Theoretical calculations and certain data show that a well pattern for input and output wells can be designed for a field so that substantially all the wet gas is recoverable.

There is practically unanimous agreement that in the development of a gas-distillate field, unit operation is fundamental. A. H. N.

1010.* Correct Well Completion and Design of Gathering Systems Important in Recycling. G. Weber. *Oil Gas J.*, 9.5.40, **38** (52), 66.—The gathering system in a recycling plant in East Texas is described. The well connections, type of equipment used, as well as well condition and completion methods, are detailed. Gravel packing is adopted in order to assure large capacity in both producing and injection wells. The paper is made complete by a map showing the plan of the field system and tables giving characteristics for well-head pressures and temperatures. A. H. N.

1011.* Surface-Controlled Intermitter Utilizes Static Fluid Column. D. H. Stormont. *Oil Gas J.*, 9.5.40, **38** (52), 88–89.—The paper describes a new type of intermitter which is entirely mechanically controlled from the surface with relatively simple controlling equipment. It is different from any other intermitter hitherto in use, in that it makes use of a static-fluid column established from the flow device to the top of the hole. This fluid column acts as a medium of control between the two points. It transmits a force applied at the surface to the bottom of the hole, where it moves a piston, which in turn directly closes the gas-valve on the intermitter. When the pressure is released from the dead-fluid column, the piston moves upward, opening the valve to allow gas to inject into the chamber. As the flow intervals and periods of gas injection are

regulated by the controls placed on the surface connections of the wells, they will operate regardless of the conditions set up in the well itself. Lifting is accomplished with low gas–oil ratios and high efficiencies.

The apparatus and method of operation are detailed. A. H. N.

1012.* Novel Clean-Out Machine on a Large Lease. D. H. Stormont. *Oil Gas J.*, 9.5.40, **38** (52), 92.—To service and clean out about 300 wells of 4200-ft. producing depth each, and located on a 22,000-acre lease, a shop-welded pipe trailer was found most effective. A 50-ft. mast was welded in a conventional manner, but was hinged at the bottom of each leg so that it folded back on the trailer when in transport or could be raised to the vertical position when on the location. Supports welded on top of the trailer allowed the mast to rest snugly on the trailer and obviated shifting. The whole assembly is hauled by a six-wheel truck on the bed of which a 75-b.p. gasoline engine and draw-works were installed. A. H. N.

1013.* Water-Flood Proves Successful in Miami County, Kansas. D. Dalrymple. *Oil Gas J.*, 16.5.40, **39** (1), 104–105.—A review of repressuring by air and by water-flooding operations is given. Results appear successful. A. H. N.

1014.* Stabilization through Proper Well Spacing. D. R. Knowlton. *Oil Gas J.*, 6.6.40, **39** (4), 16.—The ultimate problem of the oil-production business is to make income exceed cost. The principal costs are three: leasehold, development, and operating. The income is from sales, the sufficiency of which depends on quantity and price. The producers have but a scant control on price. The quantity of current sales is controlled (in U.S.A.) by regulatory proration in some States, and by purchaser or pipe-line proration in others. The quantity of ultimate sales is limited to the quantity of recoverable oil in the reservoir. Hope for stabilization therefore lies in reducing costs. In these there is but slight control over leasehold costs.

The reduction of developing and operating costs offers the best possibilities for improving the producers' businesses. There is one simple principle and two simple means for effecting such improvements.

The principle is to develop reserves with less capital expenditure than is necessary at present. The means are to use wide well spacing and unit operations of pools.

This principle and the two means for reducing costs are discussed after the analysis, and their application is illustrated by studying cases in Magnolia and Texas. In particular the short-sightedness in not adopting unit controls is condemned.

A current example of the results possible under unitization is found in Oklahoma, where a pool is developed under unit production by four operators. This control made it possible to develop the reservoir efficiently and to take advantage of a pronounced and efficient water drive. The sands have zones of varying permeability, and for efficient development, it was decided to reduce the rate of withdrawal and pressure maintenance was instituted. Over 4½ million brl. of crude have been produced in the last 2 years, with a bottom-hole pressure drop of only 4 lb. The lifting cost has been only 3·1 cents/brl. A. H. N.

1015.* Co-Operative Repressuring Plan Yielding Returns in Louisiana. G. Weber. *Oil Gas J.*, 6.6.40, **39** (4), 38.—The history of the field discussed is one of boom production and decline at a rapid rate. Several factors contributed to the reversals. Close drilling, on a 20-acre spacing pattern over much of the field, was not justified on the basis of reserves, and was found unnecessary for drainage. This was rectified later, and operators reverted to 40-acre spacing for later drilling development. Pipe-line proration and reductions in crude prices contributed further to the field's decline in importance, and reservoir pressure dropped rapidly in the absence of an effective water drive. Details are given.

A co-operative repressuring plan is now yielding returns to operators who adopted it recently. The system is described and illustrated in some detail. Initial investment, following completion of the well, has been nominal, and operating costs are low, contributing to success of the co-operative conservation project. Reversal of the production decline of many months has resulted. A. H. N.

1016.* Retrograde Condensation and Distillate Wells. F. W. Laverty. *Oil Wkly*, 6.5.40, **97** (9), 13–18.—Up to the critical temperature, compressing hydrocarbon gases at constant temperature results in increased condensation into the liquid phase. Above it the opposite occurs—*i.e.*, retrograde condensation where the liquid phase diminishes with increase in pressure at constant temperature. Retrograde condensation occurs only when a mixture of gases is compressed. The greater the difference in critical temperatures of the components of the mixture, the greater the range in which retrograde phenomena will occur.

Graphs are reproduced to show the relative amounts of fluid in the reservoir at various temperatures and pressures, assuming a case of a reservoir with a mixture of light hydrocarbons. The liquid phase increases with increase in pressure up to 1000 lb./sq. in., the retrograde point, after which it diminishes to zero at 2500 lb./sq. in. and 60° F. The retrograde point is practically the same for various curves of constant temperature, but the higher the temperature the lower is the pressure at which the liquid vanishes.

The principles of retrograde phenomena are applied to production practices in the so-called distillate wells, where the crude is maintained in the vapour state, by maintaining the pressure at the appropriate value for the particular crude, and thus greatly decreasing irrecoverable crude which would condense and wet the sand grains.

The first matter to be settled when the distillate field is drilled in is to determine the quantity of distillate that can be produced, the fluid ratio, the optimum working pressures, and the pressure to which it will be necessary to recompress the gases to return the residue gas to the formation. Typical cases are studied to illustrate the procedure. A. H. N.

1017.* Injection Method for Salt-Water Disposal. Part 2. B. Mills. *Oil Wkly*, 6.5.40, **973** (9), 19–26; cf. Abstract No. 914 for **Part 1.**—The first instalment of this article discussed conditions generally conducive to salt-water injection, and specifically outlined the nature of disposal efforts in the East Texas field. Descriptions of disposal plants and wells operated by Tide Water Oil Co. and Magnolia Petroleum Co. were also included. The second instalment describes several additional plants operating successfully in East Texas.

In each case a flow-sheet diagram is given, supplemented by photographs of various components of the plant. A. H. N.

1018.* Portable Meter Units Aid in Special Well Gauging. Anon. *Oil Wkly*, 6.5.40, **97** (9), 27.—Two principal factors are involved in taking the potential of a well: (1) the actual recording of the reservoir pressure in lb./sq. in. for each given rate of production; and (2) the accurate gauging of the fluid as it comes from the well.

The paper describes a gauging unit mounted on automobile chassis for portability, designed to solve the second problem without undue congestion at the wells to be tested. A. H. N.

1019.* Paint Coatings Reduce Air Deterioration of Casing. F. R. Cozzens. *Oil Wkly*, 6.5.40, **97** (9), 36.—Air-pressuring wells eventually results in rapid deterioration of casing, tubing, and other underground equipments, due to oxidation, particularly in localities where salt water is prevalent. To reduce the rate of deterioration, paints and pipe insulators have been used, the treatments having to be resistant to acids, alkalis, salt, sulphur, iron, and to resultant oxides.

A treatment of outstanding merit under practical field tests consists of using two paints, a combination of asphalt and aluminum. The method is described. A. H. N.

1020.* Modification of California Proration Formula Proposed. Anon. *Oil Wkly*, 6.5.40, **97** (9), 41.—A detailed and illustrated discussion is made of the failure of the present proration formula in certain instances, and a new one is outlined. The modified formula has three component parts. The first is a gradual reduction in the minimum allotment. The second is reduction in the remaining allotment resulting from a change of power factor. The third part contemplates continued reduction of the top allotment, which, however, because of the contributions of the preceding two steps, will not be as drastic as the top allotment cuts which have been made since June 1939. A. H. N.

1021.* Injection Method for Salt-Water Disposal. Part 3. B. Mills. *Oil Wkly*, 13.5.40. **97** (10), 19–27.—This paper concludes the symposium on the procedure and methods employed by East Texas injection systems for salt-water disposal. Again flow-sheets, photographs, and a detailed description are given for each plant discussed.

In conclusion it is stated that experience in the East Texas field indicates that salt-water disposal wells may be a suitable method in several localities. However, proper conditions must be in existence for the procedure to have possibilities of success.

A. H. N.

1022.* Review of the Principles of Oil Reservoir Performance. T. V. Moor. *Oil Wkly*, 3.6.40, **97** (13), 15–18. *Paper presented before American Petroleum Institute.*—A summary of the conclusions obtained is as follows: Production of oil is accomplished by displacement of oil from the pores of the sand either with gas or with water. In both cases some oil is left in the sand, because sands which contain only a small amount of oil do not readily transmit oil through their pores. Less oil is left in a sand from which oil has been displaced by water drive than would be left by a gas drive. In water-drive fields it is important that production be sufficiently slow to permit the water to flood the fine as well as the coarse sands. Gas caps should not be permitted to decrease in size due to production at excessive gas–oil ratios. Wells are important mechanical units, and must be completed properly and kept in good repair. A number of strategically located wells is necessary to provide for adequate control of the displacement of oil by water or gas, but otherwise the number of wells drilled is of minor importance.

When multiple zones of oil-bearing sand are present, the displacement of oil can be carried out most efficiently by producing one zone at a time.

The gas and water must be conserved; and, unless the reservoir contains an ample supply of these fluids to provide for the displacements of all recoverable oil, it may be advisable to return at least a portion of the gas or water produced to the reservoir. Production operations should be carried out in such a manner as to keep recoverable oil concentrated in as small a part of the sand as possible.

A. H. N.

1023.* Prevention and Removal of Paraffin Accumulation. W. Y. Brown. *Oil Wkly*, 3.6.40, **97** (13), 22. *Paper presented before American Petroleum Institute.*—This study is founded on the opinions and facts furnished by individuals and companies in reply to a questionnaire recently circulated to producers throughout the industry under the sponsorship of the American Petroleum Institute. Thus the paper discusses means and methods now popularly employed in the oil-producing areas of the U.S.A. for both preventing and removing paraffin accumulation, with particular reference to new and improved techniques which have appeared during the past decade.

The problem is considered only from the producer's standpoint, which includes both prevention and removal of waxy deposits laid down by most crude oils in their movement from an underground reservoir to lease storage tanks.

The paper is a long one and treats the causes for wax deposition as a foundation study for its prevention and removal. The questionnaire survey shows that methods now being used by operators to remove paraffin deposits in the old fields include batch treatment of hot water, steam, gasoline heat generators; and commercial solvents or softeners.

A. H. N.

1024.* Balancing Unequal Central Power Loads. Anon. *Oil Wkly*, 20.5.40, **97** (11), 45–47.—In general, the switch from flowing to pumping wells does not occur all over a lease simultaneously, but is a gradual transition, beginning with the locations nearest the source of water drive or towards the edge of the field where the sand thins out. Under such conditions it is necessary to balance the central power with "dummies." These counterbalances are tied in to the power as a well would be, with the load of lifting the counterbalance weight spaced to offset the return stroke of the rods in an oppositely situated well.

The methods of calculating and installing counterbalance weights are briefly described. Illustrations show typical installations.

A. H. N.

1025.* Compressed-Air Repressures Sand, Cleans Wells, etc. Anon. *Oil Wkly*, 27.5.40, **97** (12), 14–18.—Compressed air used for formation repressuring has been

adapted to perform a variety of other duties in a field in Oklahoma, including cleaning out of pumping wells, operation of central pumping powers, lifting and handling of engine jacket, interstage and high-pressure cooling water, etc. Some of the procedures are innovations of interest.

Special fittings and procedures are adopted so that now, after many attempts, a dirty well can be cleaned efficiently and with little power expense. A detailed description of the equipment and procedure is included.

An interesting item is the use of the compressed air in the compressor lubricating system. As an air control float falls below a predetermined height, it sets in operation the air-lifting mechanism, which brings oil from a well to a separator, from which air-free oil flows by gravity to a second tank. Safety devices are described. A. H. N.

1026.* Estimating Recoverable Oil of Curtailed Wells. W. W. Cutler, Jr., and H. R. Johnson. *Oil Wkly*, 27.5.40, **97** (12), 19.—Since almost all oil wells in the U.S.A. have been produced under curtailment, the usual method of plotting production decline curves from records of unrestricted production during equal intervals of time and of estimating future production by extending these curves has become impossible in the majority of cases. Various methods utilizing data obtained under curtailed conditions, such as the volumetric method and methods using bottom-hole pressures for estimating recoverable oil, are reviewed.

A solution for the problem is, however, offered, which takes the form of plotting curves for curtailed and uncurtailed conditions. An explanation of the method is given. It is believed that this construction of production decline curves from production records of curtailed wells is theoretically sound. However, its results will depend entirely on the reliability of the potential recorded. The older the field, the more reliable should be the recorded potentials.

Family curves for groups of wells may be made from the production decline curves of curtailed wells in the same manner as from curves of uncurtailed wells.

The authors are of opinion that for fields where accurate production and potential test records are available, this method will furnish reliable estimates of recoverable reserves of oil. A. H. N.

1027.* "Killing" Wild Gas Well. K. C. Sclater. *Petrol. Engr*, May 1940, **11** (8), 23–24.—After a gas well was completed it blew out at the surface some distance from the well. A small crater formed about 150 yards away, and the gas then blew out in a water well which had been drilled to supply water for the boilers. Attempts to kill the well, first with mud and then with cement, proved entirely unsuccessful, and the cement appeared at the crater.

The use of a spring packer was equally a failure. It seemed certain, however, that if the tubing was packed off the casing near the surface, killing the well would be facilitated. A chain packer was designed and used successfully in conjunction with golf balls.

The packer consisted of a number of chains suspended from a collar welded to the outside of the tubing. The lower ends of the chain were welded to another collar, which floated freely on the tubing, but which was temporarily fixed thereto by small cross-wires. Just below the chain packer was a special coupling with a sidewall opening and a deflector for the sealing material pumped down the tubing.

The chain packer was lowered 20 ft., the cross-wires were cut, and golf balls were pumped down, using a lubricator at the head of the well, fifteen at a time. The arrangement formed an effective seal, after which the well was killed using water, then mud, and finally cement. A. H. N.

1028.* Removal of Drilling Mud from Formation by Use of Acid. S. C. Morian. *Petrol. Engr*, May 1940, **11** (8), 117.—Research and development work have been in progress in an effort to design a method to remove the mud sheath from sand formations. Such materials as commercial hydrochloric acid, various mud thinners and conditioners, mechanical washers, as well as acid-soluble mud have been used. Of these only acid-soluble mud proved practical on any large scale.

Since not all operators use this type of mud, attempts were made to devise a solvent for ordinary muds. Conclusions regarding the formula, volume, and technique of application of the mud acid to be used are outlined. It is compared with hydrochloric acid and found superior in various respects.

The most satisfactory results have been obtained when using 1000 gal. of acid for each 10 or 15 ft. of exposed pay section. Half of the total volume may be mud acid and the balance composed of a wash solution.

The basic technique followed in new wells is outlined. This consists of washing with and then injecting the mud acid into the pay, followed by swabbing to bring in the well. A. H. N.

1029. Screening Effects of Gravel on Unconsolidated Sands. B. Gumpertz. *Petrol. Tech.* (*A.I.M.M.E.*), May 1940, Tech. Pub. No. 1195, 1–8.—Apparatus is described in which the screening effects of gravel on unconsolidated sands can be examined. This consisted of a gently tapering column of sand with a gravel section at the outlet end. Oil was driven through the sand and gravel at different rates by gas under pressure, and the rate of oil and sand efflux was determined at intervals. The sand distribution within the gravel was also determined.

It was found that the largest grains of a gravel to be used for screening unconsolidated sand over the entire range of flow velocities should bear a diameter ratio of 11 to the sand at the 10 percentile analysis. For velocities below $1{\cdot}0 \times 10^{-3}$ ft./sec. at the well surface this ratio can be increased to 16. The minimum width of the walls of a gravel pack, to give good screening action, seems to be that just sufficient to start bridging action. This width may be that of several grains of the gravel. In a gravel pack there is no relation between flow velocity and gravel-sand size ratio and the distribution of sand in the pack. Some sand was found to migrate the length of the pack in all cases. G. D. H.

1030. Factors Influencing Permeability Measurements. A. J. Carlson and M. C. Eastman. *Petrol. Tech.* (*A.I.M.M.E.*), May 1940, Tech. Pub. No. 1196, 1–6.—An air permeameter suitable for permeability measurements on core samples is described. It was found that the method of cutting the sample had no significant effect on the permeability value, and the condition of the exposed surfaces did not seem very important. Sealing-wax mounting gave more consistent results than the use of a rubber stopper, probably due to air by-passing between the sample and stopper in the latter case in some core-holders. Turbulent flow is probably responsible for some discrepancies in permeability measurements, but for the cores tested it would appear that turbulence could be avoided by keeping the rate of flow below 1 ml./sec./sq. cm., measured at the mean pressure in the sample. G. D. H.

1031.* Modified Formula before Producers. Anon. *Petrol. World*, May 1940, 37 (5), 136.—A new method of allocating production to individual wells is proposed. If the revised method is accepted it will give greater weight to the potential factor and less to the depth factor than has been practised hitherto.

The plan, as presented, has three parts :—

(1) A gradual reduction in the minimum depth allotment.
(2) A reduction in the remaining allotment by changes in the power factor.
(3) Continuation of the reductions in top allotment, but on a less severe basis than has been the case in the past. A. H. N.

1032. Patents on Production. E. V. Watts. U.S.P. 2,198,957, 30.4.40. Appl. 3.9.37. Cellular sucker-rod string consisting of individually sealed hollow sections joined end to end, the ratio of external diameter to wall thickness of each section decreasing with depth.

G. J. Barrett and S. Robichaux. U.S.P. 2,199,020, 30.4.40. Appl. 17.5.38. Cutting tool for cutting pipe inside a well.

L. S. Smith. U.S.P. 2,199,085, 30.4.40. Appl. 5.4.39. Oil-well shut-off.

G. A. Humason and W. J. Clay. U.S.P. 2,199,225, 30.4.40. Appl. 17.9.37. Pressure sampling device.

J. M. Hait. U.S.P. 2,199,490, 7.5.40. Appl. 18.4.38. Submersible pump.

C. Howard. U.S.P. 2,200,172, 7.5.40. Appl. 10.6.37. Tubing cutter.

K. Calvert. U.S.P. 2,200,487, 14.5.40. Appl. 2.11.38. Bullet-type casing perforator.

J. H. McCabe. U.S.P. 2,200,630, 14.5.40. Appl. 12.12.38. Pressure-tank gauge and sampling device.

F. A. Thaheld. U.S.P. 2,200,758, 14.5.40. Appl. 25.1.36. Rod guide for pumping wells.

F. H. Eckert. U.S.P. 2,200,790, 14.5.40. Appl. 16.6.38. Pump jack.

R. A. Wilson and R. A. Smith. U.S.P. 2,200,943, 14.5.40. Appl. 24.11.36. Well-pumping device.

E. Kerman. U.S.P. 2,201,096, 14.5.40. Appl. 5.7.38. Method of locating and repairing suction strainer damages in wells.

H. M. Greene. U.S.P. 2,201,209, 21.5.40. Appl. 4.3.39. Method and means for perforating well casings by attaching a charge to the casing itself.

E. P. Halliburton. U.S.P. 2,201,311, 21.5.40. Appl. 24.12.36. Apparatus for indicating the position of devices in pipes by causing a vibration to ensue on its passing a joint in the pipe. The vibrations are recorded at the surface.

K. Ford. U.S.P. 2,201,433, 21.5.40. Appl. 16.1.39. Liner hanger.

S. A. Mullins. U.S.P. 2,201,447, 21.5.40. Appl. 27.5.38. Fluid taking tool for oil wells or the like.

B. E. Parrish. U.S.P. 2,201,451, 21.5.40. Appl. 27.2.37. Well swab.

W. K. Thomas. U.S.P. 2,202,034, 28.5.40. Appl. 1.6.37. Well heater.

H. F. Cypher. U.S.P. 2,202,192, 28.5.40. Appl. 24.7.39. Casing-head structure comprising a tube to be inserted in casing with a tight seal between it and the casing, the tube having a valve under control.

W. S. Sease. U.S.P. 2,202,404, 28.5.40. Appl. 25.5.38. Apparatus for determining horizon productivity of wells having a velocity-responsive element which electrically translates rate of flow in well into signals at surface.

E. Topanelian. U.S.P. 2,202,439, 28.5.40. Appl. 9.8.38. Pumping apparatus with surface-operated deep well motor.

J. D. Nixon. U.S.P. 2,202,462, 28.5.40. Appl. 7.11.38. Means for intermittently controlling the flow of fluids.

J. C. Myer. U.S.P. 2,202,504, 28.5.40. Appl. 26.4.39. Device for controlling the transmission of power to pumps in a centralized pumping system.

M. F. Aloi. U.S.P. 2,202,887, 4.6.40. Appl. 26.6.39. Well-casing perforator using explosives and projectiles.

F. E. Steele. U.S.P. 2,202,970, 4.6.40. Appl. 14.3.38. Oil-well pump.

F. C. Kniss. U.S.P. 2,203,265, 4.6.40. Appl. 22.5.37. Perforating gun for oil wells.

E. B. Hall and A. L. Armentrout. U.S.P. 2,203,595, 4.6.40. Appl. 21.4.36. Device for use in wells, being a formation tester. A. H. N.

Cracking.

1033. Patent on Cracking. M. Pier. U.S.P. 2,203,470, 4.6.40. Appl. 21.7.37. Process for cracking hydrocarbon mixtures boiling above 250° C., which are substantially free from asphalts, sulphur, and nitrogen compounds, and which result from the reduction of carbon monoxide. The hydrocarbon mixture is preheated with a refining agent having an acid reaction and then subjected to cracking. H. B. M.

Hydrogenation.

1034. Patents on Hydrogenation. J. Blumenfeld. E.P. 520,201, 17.4.40. Appl. 14.10.38. Catalytic hydrogenation of ketones and aldehydes carried out in a substantially anhydrous medium in the presence of an alcoholate which is soluble in the substance to be hydrogenated, *e.g.*, *iso*propylate.

H. E. Potts. E.P. 521,391, 21.5.40. Appl. 18.10.38. Process for the destructive hydrogenation of liquid distillable carbonaceous materials containing solid matter in dispersion with hydrogen or gases containing free hydrogen under high pressures and at a high temperature. A tube preheater is used which is provided with return bends which have internal parts in the form of a scoop, constructed of, or coated with a corrosion-resistant material having a Brinell hardness of more than 400.

H. B. Kipper. U.S.P. 2,199,633, 7.5.40. Appl. 1.7.38. Process for chlorination and dehydrogenation of petroleum hydrocarbons to produce unsaturated chlorinated hydrocarbons. The hydrocarbons are treated simultaneously with chlorine and nitric acid at temperatures below 150° C. H. B. M.

Polymerization.

1035.* Thermal Reforming Plus Polymerization Pulls Octane Ratings Upward. R. P. Mase and N. C. Turner. *Nat. Petrol. News*, 3.4.40, **32** (14), R. 113–R. 114.—The disadvantage of the high gas loss attendant on thermal reforming is minimized by combining the process with polymerization. In a particular instance given the yield of reformed product of 70 octane number was 80%. This yield may be increased by 5% by polymerization without alteration of the octane number. Alternatively, by working to a constant yield, a gain of 2·5 in the octane number may be obtained. H. G.

1036. Polymerization of Ethylene by Alkyl Radicals. J. C. Jungers and L. M. Yedandapalli. *Trans. Faraday Soc.*, 1940. **36**, 483–493.—The polymerization of ethylene by alkyl radicals has been examined. The yield for any one radical increases with increasing ethylene pressure, decreasing (alkyl) iodide pressure, and light intensity. For the radicals taken together it decreases down the series methyl, ethyl, *n*-, and *iso*-propyl. The polymer is formed by bimolecular additions of ethylene molecules to radicals. The differences in the photodecomposition rates of the alkyl iodides and their polymerization yield differences are explained in terms of steric factor. The structural differences between *n*- and *iso*-propyl iodides are clearly revealed both in their photodecomposition rates and polymerization yields. Two mechanisms account for the disappearance of radicals in this polymerization—*i.e.*, saturation through capture of a hydrogen atom and bimolecular recombination of radicals. D. F. R.

1037. Patents on Polymerization. E.I. Du Pont de Nemours. E.P. 520,255, 18.4.40. Appl. 17.10.38. Separation of volatile constituents from a liquid composition containing heat-polymerizable unsaturated organic compound by bringing an inert gas into contact with the liquid composition and entraining the volatile constituents with the gas.

Standard Oil Development Corp. E.P. 521,023, 9.5.40. Appl. 10.11.38. Process for the production of polymers of halogenated *iso*-olefins. A halogenated *iso*-olefin is treated in the liquid state with a non-volatile mineral acid of between 50% and 100% strength at a temperature between 40° and 100° C. Thereafter the polymers so formed are separated from the reaction mixture.

F. T. Hamblin. E.P. 521,489, 23.5.40. Appl. 19.8.38. Preparation of a polymerizable composition comprising methyl methacrylate in admixture with a polymerization inhibitor, which in the presence of methyl methacrylate at 100° C. or above is volatile, in such proportion that it has substantially inhibitory properties at temperatures up to 40° C., but has substantially no inhibitory properties at temperatures of 100° C. or above.

J. A. Franceway. U.S.P. 2,201,767, 21.5.40. Appl. 2.7.36. Production of polymers of high molecular weight and soluble in lubricating oils by subjecting substantially

saturated oxygen-containing material to a high tension electric discharge for a period sufficient to effect substantial polymerization. H. B. M.

Refining and Refinery Plant.

1038.* Refineries Operating in United States, Canada, and Mexico. Anon. *Oil Gas J.*, 28.3.40, **38** (46), 157.—A list is given of the refineries in the United States, Canada, and Mexico, with details of personnel, crude oil capacity, cracking capacity, type of refinery, and type of cracking plant. C. L. G.

1039.* 100 Refineries Now Converting Mercaptans with Copper Salts. M. G. Van Voorhis. *Nat. Petrol. News*, 17.4.40, **32** (16), R. 122–R. 129.—Two copper-sweetening processes are in use—viz., the dry or solid process, and the liquid process. In the former the gasoline to be treated is passed through a bed of Fuller's earth impregnated with cuprous chloride. In order to provide for the continuous regeneration of the reagent, filtered air, in amount dependent on the mercaptan content, is dissolved in the gasoline by bubbling air through the charge in a small mixing chamber. Small, controlled amounts of water are also incorporated by admitting steam at intervals. In the liquid process gasoline is agitated with 40% volume of a solution containing 14% wt. $CuSO_4.5H_2O$ and 13% wt. NaCl. Agitation is accomplished in a centrifugal pump constructed from corrosion-resistant metal, and settling takes place in a glass-lined tank. Regeneration of the reagent is carried out by aeration in a wooden tank. Residual copper salts in the treated gasoline, if present, are removed by washing with alkaline sodium sulphide. H. G.

1040.* Caustic Wash takes most of the Load Off Doctor Sweetening Process. Anon. *Nat. Petrol. News*, 3.4.40, **32** (14), R. 115–R. 116.—In the example given, gasoline is treated with 20% volume of 10% NaOH solution in a two-stage continuous wash system installed before the conventional "doctor" sweetening process. By this means 60–65% of the mercaptans are removed. The resulting product is claimed to possess a higher susceptibility to tetraethyl lead, representing a saving of 0·10–0·15 c.c. per gallon. H. G.

1041.* Preventing Condenser Scale. F. J. Mathews. *Petrol. Times*, 23.3.40, **43** (1106), 264–265.—Sodium metaphosphate added to condenser feed-water has the effect of increasing the temperature and/or concentration at which calcium carbonate is precipitated. Examples are given in which the addition of the reagent in amount equivalent to 2 p.p.m. has postponed descaling indefinitely. Dosage depends on local conditions and whether the feed system is open or closed. In closed systems periodic replenishment is necessary owing to the slow conversion of the metaphosphate into the orthophosphate. H. G.

1042. Patents on Refining and Refinery Products. J. Bibby and Sons. E.P. 520,233, 18.4.40. Appl. 11.10.38. Process for the removal of impurities from oil or other liquid by the addition of a solid absorbent and subsequent removal of suspended matter by a process of electrostatic precipitation.

S. F. Warren. E.P. 521,417, 21.5.40. Appl. 18.11.38. Improvements relating to solvent-extraction processes. A number of solvents are used having different boiling points, and are brought into heat-exchange in such a way that the vapours of each solvent of a higher boiling point give up their latent heat of condensation wholly or partly to the solution in the solvent with the next boiling point. The lower-boiling point liquid is thus caused to evaporate without any more energy being used than is necessary to evaporate the solvent with the highest boiling point.

C. M. Loane and B. H. Shoemaker. U.S.P. 2,199,108, 30.4.40. Appl. 13.12.37. Preparation of a petroleum product of the class of oils and waxes highly resistant to oxidation containing a technical white oil obtained from a high-sulphur crude oil, in small but sufficient quantities to render the petroleum product resistant to oxidation.

B. Clayton. U.S.P. 2,199,401, 30.4.40. Appl. 1.8.39. Refining animal and vegetable oils containing free fatty acids and colouring matter. An alkaline refining

agent is mixed with the oils at a temperature sufficiently high to prevent the formation of a stable emulsion. H. B. M.

E. R. P. E. Retaillau. U.S.P. 2,200,703, 14.5.40. Appl. 18.5.38. Refining of hydrocarbon oils by the injection into heated hydrocarbon vapours of an aqueous solution having a concentration of 0·2–20% of a reagent consisting of sulphuric acid. 0·02–1 lb. of reagent is used per barrel of oil.

E. R. P. E. Retaillau. U.S.P. 2,200,704, 14.5.40. Appl. 18.5.38. Refining of hydrocarbon oils by the injection into heated hydrocarbon vapours of an amount of a dilute reagent solution having a concentration of 0·5–20% in a solvent which is chemically inert and which consists predominantly of organic sulphonic acid. 0·05–1 lb. of reagent is used per barrel of oil.

H. J. Willmann. U.S.P. 2,203,373, 4.6.40. Appl. 24.12.38. Method of deodorizing non-drying animal and vegetable oils, fats and waxes by subjecting them to the action of X-rays.

Fire Prevention.

1043.* Causes, Prevention, and Control of Fires on Light Liquid Hydrocarbons. H. A. Heiss. *Oil Gas J.*, 28.3.40, **38** (46), 135.—The recent increase in the recovery of light petroleum fractions for use in, *e.g.*, polymerization and alkylation processes has led to the paying of greater attention to the fire hazards involved in the storage and handling of such products. A major oil company has developed a programme of study in the reduction of these hazards by the education of employees on the fundamental properties of light petroleum products and the nature of their fire hazards, and by experiments on methods of extinguishing and improvements to equipment to eliminate fire hazards.

A discussion of this programme is presented, demonstrations used in the lectures being described. The second part deals with the types of fires possible, their probable location, and the most effective means of extinguishing. Fires are possible in process equipment lines and pumps or storage tanks, the last-named being the most likely. Experiments were carried out in a 3 ft. diam. 7 ft. high tank, containing absorption naphthas, and using as extinguishers fire foam, carbon dioxide, and steam. It was found that open tank fires of absorption naphthas of vapour pressure higher than 35–40 lb. could only be extinguished with fire foam with difficulty, and required more than the rate of 0·1 cu. ft. per sq. ft. per minute, which was found effective for naphthas of lower vapour pressure. Steam alone was not found effective even for stocks of 30·4 lb. vapour pressure, while carbon dioxide alone was effective on stocks of 43·8 lb. vapour pressure, but required excessively large quantities. Vent fires could not effectively be extinguished with fire foam or CO_2, while the application of CO_2 over a layer of foam was effective, but required impracticably large quantities of CO_2. The application of steam (or possibly CO_2) to the base of the flame appears to be the most satisfactory method. Water in the form of fog directed in a horizontal direction across the opening of the vents from a point 3–6 ft. upwind from the flame was also successful. It is recommended that a non-explosive atmosphere should be maintained in the vapour space of the tank to eliminate the risk of roof removal by explosion, and prevent open tank fires. Pressure relief equipment, grounding the tanks as protection against lightning, and location in an isolated area would also minimize the possibility of rupture from causes other than internal pressure. C. L. G.

Chemistry and Physics.

1044. Hydrogen Fluoride as a Condensing Agent. X. Rearrangements. J. H. Simons, S. Archer, and D. I. Randall. *J. Amer. chem. Soc.*, 1940, **62**, 485–486.—The authors report exchange reactions in which hydrogen fluoride was used as the catalyst instead of other more commonly used agents. These rearrangements were *tert.*-butylbenzene with phenol at 0° C. to give benzene and *tert.*-butylphenol, the latter in 10% yields; benzophenone oxime to benzanilide in the Beckmann rearrange-

ment (72% yield); phenyl acetate to *p*-hydroxyacetophenone in poor yields at 100° C. (Fries rearrangement); *p*-cresylbenzenesulphonate to 2-hydroxy-4-methyldiphenyl sulphone in yields of 10%—this also at 100° C. R. D. S.

1045. New Route to 9-Alkyl- and 9-Aryl-anthracenes. C. K. Bradsher. *J. Amer. chem. Soc.*, 1940, **62**, 486–488.—This consists of cyclization of *o*-benzyl phenyl ketones by refluxing in a mixture of hydrobromic and acetic acids, a reaction seemingly characteristic of the β-(β-styryl) vinyl alcohol structure. R. D. S.

1046. Dehydration of Some Tertiary Alcohols Containing the *cyclo*Hexane Ring. W. A. Mosher. *J. Amer. chem. Soc.*, 1940, **62**, 552–554.—1-Methyl*cyclo*hexanol, 1-ethyl-*cyclo*hexanol, 1-*iso*propyl*cyclo*hexonal, and dimethyl*cyclo*hexylcarbinol were prepared and dehydrated with iodine and the resulting olefins ozonized. From the analysis of the products of ozonolysis the ratios of the isomers in the dehydration products were determined. Dehydration will apparently take place in such a manner that the double bond occurs principally in the ring when this is possible—that is to say, the hydrogen atoms attached to the ring are less firmly bound than those of a more aliphatic nature. A proton is lost more readily from the *cyclo*hexane ring than from a methyl, ethyl, or *iso*propyl group. R. D. S.

1047. Synthesis of 6-Hydroxy-3 : 4-Benzpyrene and 8-*iso*Propyl-1 : 2-Benzanthracene from 9 : 10-Dihydrophenanthrene. L. F. Fieser and W. S. Johnson. *J. Amer. chem. Soc.*, 1940, **62**, 575–577.—6-Hydroxy-3 : 4-benzpyrene was formed by cyclization of 4-chryseneacetic acid which was prepared by the Reformatsky conversion, followed by dehydrogenation, of 4-keto-1 : 2 : 3 : 4-tetrahydrochrysene; the preparation of this latter from 9 : 10-dihydrophenanthrene has already been described. The synthesis of 8-propyl-1 : 2-benzanthracene involved dehydrogenation of a hydrocarbon mixture prepared from 8-keto-3 : 4 : 5 : 6 : 7 : 8-hexahydro-1 : 2 benzanthracene, another compound obtained from 9 : 10-dihydrophenanthrene. R. D. S.

Motor Fuels.

1048.* Autoxidation and Gum-Forming Tendencies of Certain Hydrocarbons. B. Berger and R. W. Bost. *Oil Gas J.*, 28.3.40, **38** (46), 81.—The mechanism of gum formation in gasoline is being studied by examining the relationship between the structure of pure hydrocarbons and their tendency to form oxygenated derivatives and gums. Eight pure hydrocarbons have been selected, four of the unsaturated cyclic series—viz., pinene, limonene, *cyclo*hexene and tetralin; three of the unsaturated acyclic series, viz., diallyl, 2-methyl-butene 2, and di*iso*butylene, and finally *iso*-octane; 24 samples of each were placed in ampoules containing 20 c.c. of the hydrocarbons, and, in addition, (*a*) 0·2 gm. benzoyl peroxide, (*b*) 0·2 c.c. butyraldehyde, and (*c*) 0·2 c.c. acetic acid. These, together with blanks, were exposed on the roof of a building for 3 months, samples being examined every fortnight for peroxide, acid, and gum content.

The pure hydrocarbons showed the greatest tendency to form peroxides, the acids (formed from the addition of benzoyl peroxide, butyraldehyde, and acetic acid) tending to favour the decomposition of peroxides in the sunlight. Peroxide formation is also restricted by the available oxygen being used in the oxidation of, *e.g.*, butyraldehyde. Pinene and limonene showed two peaks in the peroxide–time diagrams, indicating the formation of two types of peroxide, whilst *cyclo*hexene, being simpler in structure, showed only one peak. No free aldehydes were found as a result of autoxidation, suggesting their immediate oxidation to acids. The pure hydrocarbons showed little tendency to acid formation, but the addition of benzoyl peroxide to the unsaturated hydrocarbons led to the formation of benzoic acid. Low acidity was found in the case of the hydrocarbons (except 2-methyl-butene 2), to which butyraldehyde was added. Acid removal is attributed to (1) decomposition in the sunlight, under the influence of peroxides, (2) addition to the double bonds of unsaturated hydrocarbons, and (3) combination with hydroxyl groups formed in the experiments. The hydrocarbons can be placed in the following order of gum formation: limonene, tretalin, pinene, diallyl, *cyclo*hexene, di*iso*butylene, 2-methylbutene 2, and *iso*-octane.

Most of the hydrocarbons reached a maximum gum formation after 4 weeks, the gum content falling on further exposure, possibly owing to its destruction by sunlight. Benzoyl peroxide increased gum formation in every case, with the exception of tetralin, available oxygen being apparently utilized in acid formation in this case. Butyraldehyde and acetic acid affected the quantity of gum formed, depending on the structure, reducing gum in the case of pinene, but increasing it in the case of diallyl. An investigation of the gums obtained by evaporating a solution in acetone and drying in air for a long time indicated that the gums formed from cyclic hydrocarbons contained two oxygen atoms per hydrocarbon unit, there being at least three units in a gum. Further work on the structure of the gums is in hand. C. L. G.

1049. Patents on Motor Fuels. A. L. Mond. E.P. 520,115, 15.4.40. Appl. 27.10.38. Process for the catalytic conversion of unsaturated hydrocarbon material, and particularly for the saturation of mono-olefinic hydrocarbons boiling within the range of gasoline, *e.g.*, octenes.

Texaco Development Corporation. E.P. 520,159, 16.4.40. Appl. 13.10.38. Treatment or production of gasoline hydrocarbons by adjusting the ratio of *iso*paraffins to olefins in a hydrocarbon of gasoline boiling range or below to at least 1 : 1 without the addition of extraneous hydrocarbons. Thereafter the mixture is subjected to the action of an alkylation catalyst and the *iso*paraffins thus alkylated with the olefins.

Les Usines de Melle. E.P. 520,257, 18.4.40. Appl. 28.10.38. Preparation of a hydrocarbon anti-knocking fuel for spark ignition engines by mixing with a hydrocarbon fuel at least 10% by volume of an aliphatic organic ester.

Standard Oil Development Corporation. E.P. 520,229, 18.4.40. Appl. 13.9.38. Production of gasoline by cracking higher-boiling hydrocarbon oil in the presence of a solid adsorptive catalyst.

Standard Oil Development Corporation. E.P. 520,564, 26.4.40. Appl. 1.12.38. Improved motor fuel composed of *iso*pentane, *iso*propyl ether, and a branched-chain saturated paraffin containing at least 8 carbon atoms in the molecule.

W. E. Lyons and W. S. Guthmann. U.S.P. 2,197,477, 16.4.40. Appl. 6.12.37. Inhibition of gum formation in a liquid hydrocarbon of the gasoline type is achieved by incorporating with the liquid hydrocarbon a small proportion of a β-diketone. The amount added is sufficient to inhibit gum formation, but insufficient materially to lower the spontaneous ignition temperature of the hydrocarbon.

M. A. Dietrich. U.S.P. 2,197,851, 23.4.40. Appl. 12.8.38. Preparation of a motor fuel consisting substantially of hydrocarbons, but having incorporated therein a small proportion of an *N*-substituted organic sulphonamide which has a boiling point of at least 300° C., a melting point below 75° C., and a high solvent power for kawri gum.

T. W. Bartram. U.S.P. 2,199,021, 30.4.40. Appl. 12.2.36. Preparation of a mineral-oil composition containing a mineral oil hydrocarbon of the type tending to form gum during storage and a small amount of a reaction product, formed by condensing substantially two molecular proportions of an aromatic compound, having a hydroxyl radical substituted on the nucleus thereof, with substantially one molecular proportion of a ketone.

P. Subkow. U.S.P. 2,201,306, 21.5.40. Appl. 12.8.35. Production of cracked and polymer gasoline by the admixture of a normally liquid hydrocarbon fraction with an alkyl halide and heating the mixture to a cracking temperature. Thereafter the mixture is commingled with a normally gaseous hydrocarbon, passed into a reaction chamber, and submitted to polymerization.

F. R. Bean. U.S.P. 2,201,553, 21.5.40. Appl. 3.4.37. Prevention of deterioration of motor fuel by the incorporation of *N*-furfurylaminophenol.

J. T. Crook. U.S.P. 2,201,965, 21.5.40. Appl. 20.12.37. Conversion of liquid hydrocarbon fuel into gaseous fuel by passing the former without admixture of air through a catalyst chamber in contact with nickel ammonium sulphate. H. B. M.

Gas, Diesel and Fuel Oils.

1050. Patent on Gas, Diesel, and Fuel Oil. Standard Oil Development Corporation. E.P. 520,568, 26.4.40. Appl. 1.4.39. Fuel for compression-ignition engines of the diesel type composed of a hydrocarbon fuel and a small amount of an organic compound, containing an oxy-nitrogen sulphur group, attached to the carbon. The ignition properties of the fuel are thereby improved. H. B. M.

Lubricants and Lubrication.

1051.* 200 Lubricant Additive Patents Issued in 1938–1939. M. G. Van Voorhis. *Nat. Petrol. News*, 6.3.40, **32** (10), R. 67.—A survey of the patent literature relating to additives to lubricating oil is presented. The reagents mentioned fall into five classes, of which extreme pressure agents represent the biggest. The other classes relate to stability at high temperature and oxidation resistance, the lowering of pour points, improvement of viscosity index, and the inhibition of bearing corrosion. H. G.

1052.* Soap-Thickened Chassis Lubricant is First Additive Application. Anon. *Nat. Petrol. News*, 20.3.40, **32** (12) R. 88–R. 89.—The article is primarily a description of a recently developed additive for lubricating oil. The dope is claimed to be a highly complex organic base with a wide range of properties. Added in small quantity to automobile engine oil it is claimed to lower pour point, increase viscosity index, and to control acidity, sludge, and lacquer formation. It is further stated that by an alteration of the chemical characteristics of the dope its properties as an additive may be altered selectively. For instance, its relative effect on pour point and viscosity index may be altered independently, and independently of its reaction towards other undesirable features in the treated oil. H. G.

1053. Patents on Lubricants and Lubrication. J. I. Wasson. U.S.P. 2,196,374, 9.4.40. Appl. 9.2.38. Improved method of dewaxing a mineral oil by mixing with it a polyester of a hydroxy fatty acid secured by auto-condensation of a high-molecular-weight mono-hydroxy fatty acid, chilling the oil, and separating the precipitated wax.

T. S. Hodgins. U.S.P. 2,196,796, 9.4.40. Appl. 17.7.39. The drying properties of oils containing naturally occurring anti-oxidants are improved by removing the anti-oxidants by treating at substantially room temperature with nitric acid. The p_H value of the materials being treated is kept only slightly acid by confining the quantity of nitric acid used to 0·025–0·50% by weight of the oil being treated. The operation is continued just until the refractive index begins to increase.

E. W. Fuller. U.S.P. 2,196,963, 9.4.40. Appl. 1.2.39. A minor proportion of a thio-aldehyde is admixed with a mineral-oil fraction in sufficient amount to inhibit the deleterious effects of oxidation on the oil.

D. R. Merrill. U.S.P. 2,197,153, 16.4.40. Appl. 23.2.37. Preparation of a normally fluid mineral oil lubricant comprising an oil-soluble organic base soap of an unsaturated fatty acid of at least ten carbon atoms condensed with an aryl compound.

W. A. Lutz. U.S.P. 2,197,433, 16.4.40. Appl. 3.2.39. Preparation of a stable oxygen-resistant, non-bleeding lubricating grease having a low absorbability in rubber by mixing 15–20% calcium stearate with 85–75% of a paraffinic petroleum oil of viscosity exceeding 500 Saybolt at 100° F. The oil must be substantially free of poly-naphthenic constituents.

A. W. Ralston and E. J. Hoffmann. U.S.P. 2,197,712, 16.4.40. Appl. 14.10.38. Preparation of a mineral-oil composition containing as a pour-point depressor, an acylated indene, the acyl group having at least twelve carbon atoms.

M. Pier and F. Christmann. U.S.P. 2,197,769, 23.4.40. Appl. 2.12.37. Preparation of a lubricant containing a mineral lubricating oil and a condensation product of paraffin wax, having a molecular weight above 350. The product has a viscosity of at least 3° (Engler) at 99° C., is soluble in hydrocarbon lubricating oils, and is effective in depressing the pour point of waxy lubricating oils. It is obtained by subjecting the wax to the action of a silent electric discharge in order to increase its viscosity.

D. E. Badertscher, H. G. Berger, and F. M. Seger. U.S.P. 2,197,781, 23.4.40. Appl. 3.12.37. Preparation of an extreme pressure lubricant by admixing with a hydrocarbon lubricating oil a small proportion of the product obtained by the reaction of perchloromethylmercaptan with an unsaturated organic material.

O. M. Reiff and E. W. Johnson. U.S.P. 2,197,836, 23.4.40. Appl. 8.10.38. Mineral-oil composition comprising a viscous mineral-oil fraction and sufficient of an oil-miscible metal salt of a keto acid to inhibit oxidation of the oil.

S. Musher. U.S.P. 2,198,210, 23.4.40. Appl. 3.1.39. An oil normally subject to oxidative deterioration selected from the group consisting of the hydrocarbon oils, glyceride oils, and essential oils can be effectively stabilized against deterioration. A stabilizing agent is used, consisting of a small proportion of sugar selected from the group consisting of crude cane and crude beet sugar.

O. M. Reiff, F. P. Otto, and J. J. Giammaria. U.S.P. 2,198,275, 23.4.40. Appl. 18.10.39. An improved mineral-oil composition is obtained by admixing with a viscous mineral-oil fraction a small proportion of a metal salt of an alkyl-substituted aromatic-aliphatic carboxylic acid in which the alkyl substituent is attached to the aromatic nucleus and is derived from an aliphatic hydrocarbon having at least 20 carbon atoms.

G. A. Hope. U.S.P. 2,198,307, 23.4.40. Appl. 30.11.37. Preparation of a lubricating composition comprising a hydrocarbon lubricant oil and in admixture therewith a small amount of a salt of a polyvalent metal.

A. Pollak and R. Hastings. U.S.P. 2,198,562, 23.4.40. Appl. 27.4.39. Manufacture of sulphurized cutting oils by heating tall oil with agitation with up to 30% by weight of sulphur in the temperature range 300–400° F. The solution of the sulphur is controlled to give a minimum of sludging by terminating the heating within 2–4 hr.

F. X. Govers. U.S.P. 2,198,575, 23.4.40. Appl. 27.2.36. Manufacture of high viscosity index lubricating oil having a low pour test from wax-bearing mineral oil.

P. J. Wiezevich, J. C. Zimmer, and A. J. Morway. U.S.P. 2,198,851, 30.4.40. Appl. 6.11.36. Preparation of an improved normally liquid lubricating oil consisting of a mineral oil, an aluminium soap, and a small percentage of a high-boiling ester selected from the class consisting of esters of polyhydroxyl alcohols with monobasic acids.

R. Rosen. U.S.P. 2,199,187, 30.4.40. Appl. 24.7.38. Composition of matter comprising a waxy mineral lubricating oil and a small amount of an ester formed from a long-chain aliphatic alcohol and a cyclic carboxylic acid. H. B. M.

C. C. Towne. U.S.P. 2,199,352, 30.4.40. Appl. 23.3.38. Improved lubricating oil is prepared by depolymerizing a dispersion of rubber in an aromatic solvent with a depolymerizing agent. The depolymerized rubber is reacted in the presence of one of a group of compounds, consisting of halides and halogen acids of tin, to produce a resinous polymer, which is thereafter precipitated and separated, and finally dissolved in a minor proportion in a petroleum lubricating oil.

V. B. Bray. U.S.P. 2,200,534, 14.5.40. Appl. 19.4.38. Preparation of a low-pour-point lubricating oil composed of a lubricating oil having a relatively higher pour point blended with a small quantity of a pour point reducing agent extracted from a cracked pitch by the use of a higher-boiling hydrocarbon-oil fraction.

E. Bösing. U.S.P. 2,201,120, 14.5.40. Appl. 17.8.38. Process for producing lubricating oil of high quality from a wax-free hydrocarbon mixture containing same, together with low-quality oil constituents.

D. E. Badertscher, H. G. Berger, and F. M. Seger. U.S.P. 2,202,641, 28.5.40. Appl. 23.11.37. Production of an extreme-pressure lubricant consisting of a hydrocarbon oil and a minor proportion of the oil-miscible product obtained by the reaction of a halogenated aliphatic hydrocarbon and an alkali thiocyanate in such proportions that the product contains both sulphur and chlorine.

O. L. Brandes. U.S.P. 2,202,826, 4.6.40. Appl. 17.1.38. Preparation of a lubricating composition for use in internal-combustion engines, etc., comprising a major amount of a mineral lubricating oil and not more than 2% by weight of nickel naphthenate and an alkylated monohydric phenol.

T. J. Brown. U.S.P. 2,203,044, 4.6.40. Appl. 11.1.39. Manufacture of a lubricant comprising a mineral lubricating oil and 2–10% of *para*-cymene to lower the pour point of the oil.

K. P. Powers. U.S.P. 2,203,102, 4.6.40. Appl. 18.1.38. Manufacture of a lubricant comprising a petroleum lubricating oil, 0·05–0·1% stearic acid and 0·05–0·5% by weight of a mild extreme pressure agent selected from the class consisting of esters and thioesters of phosphorus acids.

T. G. Roehner, E. S. Carmichael. U.S.P. 2,203,507, 4.6.40. Appl. 11.12.37. Manufacture of a lubricant containing more than 50% of a heavy mineral-oil fraction, about 20% of palm oil, and about 20% of substantially non-corrosive sulphur-containing extreme-pressure lubricant bases.

Standard Oil Development Corporation. E.P. 520,792, 3.5.40. Appl. 1.11.38. Method for renewing the oxidation and decomposition resisting properties of lubricating oil during use. Successive portions of the oil are circulated through a bed of an oxidation and decomposition resisting substance which has a low solubility in oil.

I. M. Colbeth. E.P. 520,970, 8.5.40. Appl. 5.11.38. Production of a lubricant consisting of a major proportion of a mineral oil and a minor proportion of an ester of a non-drying long-chain aliphatic acid obtained from a natural oil and having at least eleven carbon atoms and a short-chain primary saturated aliphatic alcohol having not more than two hydroxyl groups. The composition is substantially free from fatty oils and also from emulsifying agents.

Socony-Vacuum Oil Company. E.P. 521,203, 15.5.40. Appl. 10.11.38. Production of a lubricating composition having incorporated a major proportion of a lubricating oil and a minor proportion of the phosphorus-amine reaction product obtained from phosphorus trichloride and an amine having at least one hydrogen atom attached directly to the nitrogen atom of the amine. H. B. M.

Asphalt and Bitumen.

1054. Patents on Asphalt and Bitumen. R. Lichtenstern. E.P. 520,525, 26.4.40. Appl. 26.5.38. Improvement of tars or asphalts by treating with metal chlorides. A basic mass is prepared by subjecting any desired bituminous material with the action of heat to the action of a concentrated solution of a metal chloride, and heating a bituminous material of the same or a different kind after incorporating with it a small quantity of the basic mass.

A. H. Batchelder. U.S.P. 2,200,484, 14.5.40. Appl. 5.4.38. Preparation of an asphaltic composition by separating asphalt into an oil fraction and an asphaltene fraction by the use of a selective solvent. Thereafter a substantially undissolved, non-colloidal dispersion of the substantially oil-free asphaltenes is formed. This has a lower viscosity than the original asphalt.

R. E. Burk and C. H. Whitacre. U.S.P. 2,200,914, 14.5.40. Appl. 14.7.38. Manufacture of asphalt by air-blowing a residuum and introducing a small amount of chlorine while heating.

E. C. Daigle. U.S.P. 2,203,081, 4.6.40. Appl. 2.7.38. Production of a blended asphaltic product by oxidizing a straight-run residuum of a highly naphthenic nature to approximately the desired penetration for the final product. Thereafter a small amount of a straight residuum of a more asphaltic nature is blended with the oxidized asphalt. Oxidation is continued until the final blended asphalt is produced possessing the desired properties. H. B. M.

Special Products.

1055.* Contribution to the Manufacture of Metallurgical Coke from Petroleum Coke. H. Hendler. *Monit. Pétr. roum.*, 1940, **41**, 445–446.—The author outlines the possibilities of utilizing, in Rumania, coke from cracking processes as a metallurgical coke. T. C. G. T.

1056. Patents on Special Products. R. Robinson and A. Lowe. E.P. 519,894, 9.4.40. Appl. 6.10.38. Manufacture of *B*-(4-hydroxy-3-methoxyphenyl)-*iso*propylamine and its salts by condensing an aralkyl ether, preferably the benzyl ether, of 4-hydroxy-3-methoxybenzaldehyde with an α-halogenopropionic ester.

Röhm and Haas A.-G. E.P. 520,164, 16.4.40. Appl. 13.10.38. Manufacture of esters of unsaturated polymerizable acids by the reaction of esters derived from these acids and from alcohols of relatively lower molecular weight with alcohols of relatively higher molecular weight, or phenols. The lower alcohols are set free and the esters of the higher alcohols formed are removed from the reaction zone during the reaction.

I.G. Farbenindustrie A.-G. E.P. 520,198, 17.4.40. Appl. 14.10.37. Extraction of phenols from aqueous solutions by bringing the solution into intimate contact with liquid esters of carboxylic acids, the boiling point of which is sufficiently below that of the phenols to allow separation of the esters by distillation.

G. T. Morgan and L. P. Walls. E.P. 520,273, 18.4.40. Appl. 7.10.38. Preparation of nitro-derivatives of phenanthridine by cyclizing an acylated nitro-*o*-xenylamine or a substitution product thereof having a free orthoposition by means of a 5-valent phosphorus compound.

Chemical Works (Sandoz). E.P. 520,396, 23.4.40. Appl. 21.10.37. Manufacture of new condensation products by the treatment with aldehydes of alkylureas of pyridinium compounds.

Gutehoffnungshutte Oberhausen A.-G. E.P. 520,480, 25.4.40. Appl. 11.10.38. Partial oxidation of gaseous or vaporous hydrocarbons in the presence of small quantities of nitrogen oxides and solid catalysts in the form of oxides which are difficult to reduce, *e.g.* oxides of silicon, zinc, magnesium, titanium, cerium, alone or in mutual admixture. The initial mixtures are passed through a number of uniformly heated tubes or ducts containing, or made of, the catalysts.

H. Frisch. E.P. 520,620, 29.4.40. Appl. 14.11.38. Production of styrene from commercial xylene by chlorinating the xylene, separating the chlorinated constituents and treating them to recover the styrene.

N. V. Orgachemia. E.P. 520,707, 1.5.40. Appl. 28.10.38. Process for the preparation of di-(*p*-aminobenzene-sulphonyl)-*p'*-aminobenzenesulphonamide and its acyl derivatives.

J. G. Fife. E.P. 521,068, 10.5.40. Appl. 17.11.38. Production of mono-alkylol ketones by reacting di-alkylol ketones with ketones, if desired in the presence of condensing agents, *e.g.*, substances showing an alkaline reaction.

Phillips Petroleum Company. E.P. 521,092, 10.5.40. Appl. 9.8.38. Process for the separation of a mixture of paraffinic and olefinic hydrocarbons having four or five carbon atoms in the molecule, into a paraffinic fraction and an olefinic fraction.

H. Dreyfus. E.P. 521,202, 15.5.40. Appl. 10.11.38. Manufacture of fatty acids from their salts by bringing carbon dioxide into contact with a solution of the salt in concentrated aqueous ethyl alcohol maintained at a temperature above 70° C.

Standard Oil Development Corporation. E.P. 521,296, 17.5.40. Appl. 12.11.38. Construction of an insulated electrical conductor, comprising as an insulating medium a low-pour-point synthetic oil consisting of reaction products having a molecular weight above about 300 and obtained by further polymerization of lower polymers containing 8–20 carbon atoms of normally gaseous *iso*-olefines.

United States Rubber Products, Inc. E.P. 521,576, 24.5.40. Appl. 8.12.38. Manufacture of aliphatic ketone-diarylamine anti-oxidants by reacting diarylamine in liquid form with an aliphatic ketone introduced in vapour form by pressure into the liquid diarylamine at a temperature between 100 and 200° C.

C. M. Alexander. U.S.P. 2,200,463, 14.5.40. Appl. 14.1.31. Production of lower-boiling hydrocarbons from higher-boiling hydrocarbons by subjecting vapours from the latter and steam to elevated temperature and pressure in the presence of potassium carbonate and condensing the vapours.

B. T. Thurman. U.S.P. 2,201,061, 14.5.40. Appl. 8.6.38. Stabilization of glyceride oil products prepared from oils having fatty acid radicals containing more than two double bonds by the addition of a vegetable phosphatidic material.

A. P. Anderson. U.S.P. 2,201,466, 21.5.40. Appl. 21.1.38. Preparation of natural petroleum plastic, translucent in thin layers, substantially free from asphaltenes, substantially solid at atmospheric temperature, completely soluble in 860 A.P.I. naphtha, and more than 75% insoluble in an equal volume of acetone at 77° F. The product has a lower temperature susceptibility than that of asphaltic resins.

V. Ipatieff and R. E. Schaad. U.S.P. 2,202,104, 28.5.40. Appl. 18.4.36. Production of di*iso*butene from a normally gaseous mixture consisting essentially of four carbon atom hydrocarbons and containing *iso*butene and normal butenes. The mixture is subjected in vapour phase at a temperature of about 210° F. and under a pressure of 100 lb./sq. in. to the action of a siliceous catalyst containing approximately 30% phosphoric acid in order selectively to polymerize the *iso*butene.

J. C. Morell. U.S.P. 2,202,115, 28.5.40. Appl. 30.12.37. Production of octanes by the subjection of butanes at a temperature of −50 to 20° C. to treatment with butenes in the presence of hydrochloric acid and zinc.

E. C. K. Montclair and A. T. Fiore. U.S.P. 2,202,387, 28.5.40. Appl. 26.3.38. Preparation of an insecticide containing a mineral oil distillate, a poly-alkyl phenol, and a third substance selected from the group consisting of rotenone, oleoresins containing rotenone, etc. H. B. M.

Detonation and Engines.

1057.* Fuel Injection Gives Safety Fuel Performance Equal to Gasoline. M. G. Van Voorhis. *Nat. Petrol. News*, 3.4.40, **32** (14), R. 106–R. 108.—The results obtained on the Wright 1820 G (single-cylinder) engine with aviation safety fuel with a flash-point as high as 134° F. are stated to be encouraging. Fuels are available which show a power output and minimum specific fuel consumption equal to that of *iso*-octane. Determinations of power output, mean effective pressures, and fuel consumption carried out on five safety fuels indicated that an increase in the distillation range has only a negligible effect on performance until the distillation range exceeds 350–500° F. Better performance was obtained when using a multi-orifice injection nozzle as compared with single-jet nozzles. The apparent disadvantages of heavy fuels as compared with gasoline are starting difficulties, extreme crankcase dilution, troubles due to low cylinder temperatures as would prevail in an idling engine during a long glide. At present an engine must be started on gasoline or propane. H. G.

1058.* Distillate Fuels for Tractors Holds Own with Gasoline. Anon. *Nat. Petrol. News*, 3.4.40, **32** (14), R. 110–R. 112.—Tests on 338 tractors over a period of 20 years by the University of Nebraska Tractor Testing Laboratory indicate that there is no tendency to use any particular fuel. On the basis of horse-power-hours per gallon distillate fuels compare favourably with gasoline. Since 1920 the average fuel consumption of tractor engines has fallen by 33%. H. G.

BOOK REVIEW.

A New Dictionary of Chemistry. Edited by Stephen Miall, LL.D. Pp. 575. Longmans, Green & Co. 1940. Price 42*s*.

This very admirable volume can be heartily recommended not only to chemists, but also, as the Editor points out, to "doctors, druggists, physiologists, chemical manufacturers, works managers, chemical engineers, patent agents, lawyers, journalists and many others." And this is no idle saying.

In the very limited space of 575 pages the contributors have packed an astonishing wealth of material, accurate and concise. A really comprehensive selection of typical examples of the numerous groups of organic substance has been successfully achieved, and a careful examination has shown that considerable judgment must have been exercised to ensure that a well-balanced choice has been effected.

The elements and their more important compounds are reviewed from a variety of aspects, crystal structures are demonstrated by X-ray analysis, representative mineral species are discussed, compounds of pharmacological importance are described, attention is given to the phenomenon of chemical change. Catalysis, thermodynamics, surface chemistry, and physics are not ignored. In point of fact the dictionary is not only filled with useful matter, but it is eminently readable as well. The appendix giving the physical constants of 1800 organic compounds is a welcome addition to the dictionary.

Special reference should be made to the biographical entries relating to chemists past and present who have made some contributions of importance to their science. This must be the first occasion on which a "Chemical Who's Who" has been published, and a delicate task it must have been. But it adds something of human interest to the dictionary when H. E. Armstrong is found reposing between Argon and Armica, or Caro cheek by jowl with Carnallite and Carotene. Perhaps one day the Editor will extend and amplify his biographies and make them up into a separate volume.

Only one complaint. Your reviewer has failed to find a disquisition on Entropy. He must confess that for many years this illusive quantity has eluded him—he did hope against hope that a definition even in the Miallian sense would be forthcoming.

It is unnecessary to say that the book is handsomely printed, bound and produced—and it is confidently predicted that it will find a place in every laboratory and in the libraries of the eminent men referred to in the first sentence.

A. E. D.

BOOKS RECEIVED.

New Zealand Official Yearbook, 1940. 9¼ × 6″, 1041 pp. End map. Pubd. Census and Statistics Division N.Z. Government. 7*s*. 6*d*.

This 48th issue of the statistical Abstract for New Zealand follows the same lines as its immediate predecessor. The statistics relate to 1938.

Under "Petroleum" it is stated that the total production of crude for the year was 116,585 gallons from three wells at New Plymouth. Following the passing of the Petroleum Act, 1937, considerable interest has been displayed by some of the major oil organizations. Fifty-nine prospecting licences have been granted over 10,514 square miles throughout the country.

The consumption of petrol during 1938 is returned as 96,896,000 gal. The total duty on motor spirit is now 1*s*. 2*d*. The proceeds from 6*d*. per gallon of this tax are earmarked for road purposes, and the balance is levied for general revenue purposes.

Imports of motor spirit, valued at £1,891,339 in 1938, mainly come from Dutch East Indies and U.S.A.

B.S.S. No. 894—1940. The Determination of the Flow and Drop Points of Fats and Allied Substances. Pp. 11. British Standards Institution, 28 Victoria Street, S.W.1. Price 2*s*.

The apparatus employed for the determination of the flow and drop points of fats and allied substances is of the Ubbelohde type. It is more closely specified than the existing I.P. standard (Method L.G. 11) chiefly as regards the dimensions of the glass cup. In the B.S. Specification the internal diameter of the cup is specified as well as the outside diameter. A further difference between the two kinds of apparatus is to be found in the length of the thermometer bulb, which has been increased in the B.S. Specification.

B.S. Glossary of Highway Engineering Terms. Pp. 77. April, 1940. British Standards Institution, 28 Victoria Street, S.W.1. Price 5*s*.

The History of Alberta Oil. By F. K. Beach and J. L. Irwin. Pp. 62, plus map. Issued by the Department of Lands and Mines. Published by the Publicity and Travel Bureau, Edmonton, Alberta.

This pamphlet gives a general review of the history and development of the oil industry in Alberta. It is concluded that for the successful maintenance and advancement of Alberta's oil industry certain factors are necessary. One is the continued conservation of the oil and gas resources of the province by means of orderly development, and another is the maintenance of a price structure that will be adequate to assure continued production of oil. Alberta produced a record year in 1939 with her total oil production of 7,594,411 brl.

International Union of Chemistry, 28 rue St. Dominique, Paris.

1. **International Table of Atomic Weights, 1940** (10th Report of Committee on Atomic Weights).
2. **International Table of Stable Isotopes, 1940** (5th Report of Committee on Atoms).
3. **Rules for the Nomenclature of Inorganic Compounds.**

The text of the first two Reports is in English, French and German; the text of the third Report is in English.

The Committee on Atomic Weights (Chairman: Prof. G. P. Baxter, Harvard) records work carried out during 1938–39, and tabulates internationally recognized atomic weights and atomic numbers of 86 elements.

The Committee on Stable Isotopes (Chairman: Dr. F. W. Aston, Cambridge) records the Atomic Numbers (Z), the Mass Numbers (A) and Relative Abundances of the stable isotopes of 83 elements. One small discrepancy was noted. The table of Atomic Weights employs the symbol "Cb" and the table of Stable Isotopes the symbol "Nb" for the element columbium (niobium).

The third Report ("Nomenclature of inorganic compounds") is "an attempt to produce a uniform, rational nomenclature, especially for scientific purposes." Some of the recommendations will doubtless arouse controversy (*e.g.*, the substitution of "halogenides" for "halides," and the discouragement of the suffixes "-ous" and "-ic" as valency indications). The impression obtained is that it is fortunate that the symbolic notation of chemistry is independent of language or personal predilection.

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Geology and Development.

1059.* Mississippian Border of the Eastern Interior Basin. J. M. Weller and A. H. Sutton. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 765–858.—The Eastern Interior Basin is a sub-circular structural depression occupying much of Illinois, Indiana, and Western Kentucky. Throughout the latter part of the Palæozoic era the Basin was a negative area determined by the positive Ozark Dome, Wisconsin Highlands, and Cincinnati Arch.

Recent classifications have divided the Mississippian system into two series: the Iowa and the Chester; it is suggested that a threefold division be made: the Kinderhook, Valmeyer, and the Chester. Despite its greater thickness, the Chester probably represents a time-interval nearer to each of the proposed lower divisions.

The relations of the Mississippian and Devonian in Central U.S. are confused. Very uniform black shale separates rocks with the characteristic faunas of the systems.

The Iowa series contains the Kinderhook, Osage and Meramec groups. In the Mississippi Valley area these are mainly cherty limestones which grade eastward into clastic sediments. The basal Kinderhook is largely shale and is generally unfossiliferous, though *Chonopectus* and *Productidæ* occur. The Osage group is generally unconformable on the Kinderhook. The fauna which represents a single slow evolutionary series includes *Syringothyris* and *Leptæna analoga*. The Warsaw and Salem limestones above are closely related and form transition beds between the Osage and Meramec groups. It is suggested that the name Warsaw be applied to all beds between the Keokuk (Osage) and St. Louis (Meramec) limestones.

The Meramec contains three limestone members which give rise to large areas of karst topography. *Endothyra baileyi*, *Lithostrotion canadense*, and *Platycrinus pencillus* are abundant.

The unconformity which separates the Meramec group from the Chester series is the most important stratigraphic break and is indicated by variations of the basal Chester beds. These consist of alternating sandstone and limestone-shale formations of variable thickness and lithology, and form three groups—the New Design, Homberg, and Elvira. The most important fossils are *Pentremites*, *Galarocrinus*, *Chonetes*, *Camarophoria* and *Eterotocrinus*.

The Chester rocks contrast with the Lower Mississippian in the wide occurrence of sands. The source of these sediments is not accurately known, though Ozarkia probably contributed much to the Eastern Interior Basin. The marine beds were laid down in shallow seas and the sandstones resemble those of the Pennsylvanian with thin coal-beds. A feature of the Series is the alternations of formations which form units closely resembling the Pennsylvanian "cyclothems". A marked unconformity occurs at the top of the Chester beds.

The structural history of the area indicates great Pre-Mississippian deformation; intra-Mississippian movements gave rise to slight doming of the Ozark region. The

close of the Mississippian period saw the positive areas surrounding the Basin domed and subjected to erosion.

Not only do the Mississippian rocks yield important amounts of petroleum, but they also produce much building stone. The chief oil and gas formations are listed, and the paper is accompanied by areal geological maps with a selected bibliography of more than one hundred entries. G. S. S.

1060.* Geochemical Exploration (Soil Analysis), with some Speculation about the Genesis of Oil, Gas, and other Mineral Accumulations. E. McDermott. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 859–881.—The rôle of surface evidences of buried accumulations of oil and gas has been much neglected. Methods of geochemical exploration permit the quantitative measurement of microscopic gas and oil seeps and mineralization phenomena which cannot be detected visually. Geochemical data show that leakage occurs from practically all buried accumulations, maximum leakage occurring over the edges of accumulations rather than over the top.

Gaseous constituents pass through microscopic fissures to the earth's surface and are subsequently adsorbed. Accompanying these, and heavier hydrocarbons, are mineral concentrations; they are the result of transportation of mineralized waters to the surface. Field results of these methods with accompanying diagrams are given.

Speculation has arisen on the origin and manner of accumulation of oil and gas. As oilfields are, with few exceptions, found in marine sediments, it is believed that salt acts as a catalytic agent in the polymerization of the migrating gases. Trask has shown that no appreciable difference exists in the organic content of marine and non-marine sediments. Experimentally, solid hydrocarbons are formed by percolating hydrocarbon gas through a salt solution.

Buried vegetable matter, basement rocks, and the earth's interior are the probable sources of the gases; these are, in ultimate origin, inorganic. The nature and amount of accumulation depend on the permeability of the cap-rock, and it appears that leakage is essentially vertical. Such cap-rocks are not necessarily source-rocks.

Very high mineral concentrations indicate the great transporting power of gases; caliche and secondary mineralization may be explained in this way. G. S. S.

1061.* Geology of the Oil-field Belt of S.W. Iran and Iraq. G. M. Lees and F. D. S. Richardson. *Geol. Mag.*, 1940, LXXVIII (3), 227–252.—The main geological features of the oil-field belt of S.W. Iran and Iraq are described. The belt includes the fields of the strongly folded Zagros foothills and those situated on the gently folded margin of the stable foreland of the Arabian littoral.

A Tertiary geosyncline extended for 1200 miles from Northern Iraq to the mouth of the Persian Gulf. Within the mountain area of the Zagros two structural zones are recognized: the normally folded zone, like the French Jura but on a larger scale, and the north-east overthrust zone. These differ lithologically, the former containing elements similar to those of the Dinarides of South-east Europe, whilst the latter are mainly metamorphics. Cambrian salt plugs are important structures in Central and South-west Iran.

Beds from the Cambrian to Recent occur, and are predominantly calcareous. The Oligocene and Lower Miocene limestone series (Asmari Limestone) is the oil-producing formation in the South-west Iranian fields, where it reaches 1500 ft. in thickness. It is overlain by the Lower Middle Miocene chemical deposits, the Lower Fars Series. Throughout the greater part of this series salt is irregularly distributed; it is known to have a thickness of 4000 ft. in certain places, and this may be exceeded elsewhere. Salt flowage occurred on a great scale during the period of the major folding movements; these resulted in the formation of various disharmonic structures, including large overfolds and overthrusts. The main north-west to south-east folding movements occurred in Upper Miocene and Pliocene times.

The oil is believed to have originated in marls deposited during Mesozoic and Palæogene times; these marls are chocolate-brown to black, evenly bedded and probably laid down in a stagnant deep-water milieu deficient in light and oxygen. Oil accumulates in the networks of the larger joints in the Limestone, the Lower Fars Series forming an effective seal. Oil or gas flows to the surface without pumping and may flow at a rate exceeding 1 million gallons a day. Middle Cretaceous limestones have also been drilled, and in the Arabian littoral these rocks contain oil.

The existing fields are situated in the foothills, especially in the wider zones in the north-west (Kirkuk) and in the south-east (Kuzistan). Seepages of oil and gas occur frequently, whilst the presence, or former presence, of gas escapes is marked by chemical changes in the surrounding rocks.

Location of accumulation is difficult because the surface structural features are often completely dissimilar to those of the Asmari limestone. This is due to the disharmonic movements of the Lower Fars, which behaved as a plastic medium between the limestone below and the relatively rigid masses of Middle and Upper Fars and Bakhtiari sediments above. It is now possible to locate the limestone anticlines by geophysical means. G. S. S.

1062.* Sedimentation. R. M. Bailey. *Oil Wkly*, 27.5.40, **97** (12), 27.—A brief account is given of various aspects of sedimentation—the sources of the sediments and the types of weathering; the different modes of transportation of sediments by water, air, or ice; the effects of transportation on the sedimentary material; the types of deposits and their spatial relationships, and the economic applications of sedimentary studies. G. D. H.

1063.* Photogrammetry and the Oil Engineer. H. T. Bruce. *Oil Wkly*, 10.6.40, **98** (1), 19.—The principles underlying the development of photogrammetry are briefly described, and the various instruments and their possibilities are noted. The use of photogrammetry and its advantages in pipe-line and geological work are discussed in a general manner. G. D. H.

1064.* Michigan Alarmed Over Lag in Discoveries. N. X. Lyon. *Oil Wkly*, 17.6.40, **98** (2), 30.—Eighteen months of intensive wildcatting have yielded no important discovery, although several notable extensions have been made. Subsurface interpretation, coupled with drilling, trend geology, or chance, has accounted for virtually all Michigan's discoveries in the past. In South-west Michigan the Traverse limestone is only 1000–1900 ft. deep, so that wildcats were cheap. A table summarizes the results of wildcatting since 1931.

In 1939 697 shallow oil wells, 3 gas wells, and 463 dry holes were drilled.

The Grand Rapids field covers 3810 acres and has 386 producing Traverse lime wells. It is 6 ml. long and ½–2 ml. wide. Three wells produce from the Berea at 1150–1200 ft. It is the most basin-ward of all the shallow oil-fields in West and South-west Michigan. The Traverse wells are 1700–1900 ft. deep. The closure is 75–90 ft.

The Bloomingdale field produces from a depth of 1200 ft.

Since 1937 all the commercial production developed in West Michigan has been in the Traverse. Few wells have gone deeper.

The Temple pool produces from the Monroe lime at 3800–3900 ft., on the Porter–Yost–Mt. Vernon trend. A saddle divides it into two parts, and it is under hydrostatic control. The Wise field gives oil from the Dundee at 3700 ft. There has been a revival of drilling for Trenton production in South-east Michigan.

At the beginning of the year reserves were estimated at 45,000,000–55,000,000 brl., 20,000,000 brl. being in shallow pools, quantities which represent only two or three years' production at present rates. G. D. H.

1065.* Active Development Programme Under Way in South Texas. N. Williams. *Oil Gas J.*, 13.6.40, **39** (5), 26.—Drilling has been increased in the Corpus Christi and lower Gulf Coast areas of Texas. The main activity is in the trend of fields running north from Sullivan City into Nueces county, and including the Rincon, Sun, Kelsey, and Colorado fields. At Rincon seven sands have been found. Sun, Kelsey, and Colorado are also new fields. Production has been extended at Robstown. Oil has been found at Wade City, which was formerly a gas-distillate producer at 4800–4900 ft. The Orange Grove field was opened in May. East Flour Bluff field is on the downthrown side of a fault bounding the Flour Bluff field. A gas-distillate well has been brought in at Bloomington. Vicksburg production has been discovered in Victoria county. At Telferner oil was found at 2692–2698 ft. The Keeran field has been extended, and east of Lolita another field has been opened in Jackson county.

Altogether fifteen fields have been discovered in South Texas this year.

G. D. H.

1066.* Petroleum Exploration by Means of Soil Analysis. J. W. Merritt. *Oil Gas J.*, 13.6.40, **39** (5), 68.—The history of the search for oil shows a development from drilling near seeps, through the search for anticlines to the geophysical discovery of buried structures. In recent years examination of the "soil air" seeping into shallow holes over oil-fields has shown a pattern of values marking the limits of the fields. Soil samples are now used for the same purpose. A set of high hydrocarbon values occurs over the margin of the oil body. This is the case where there is a dome, fault, shore-line, or other stratigraphic trap.

Laboratory technique seems to be advancing more rapidly than interpretation. Profiles should be sufficiently long to determine the outer margins of possible annular oil bodies. The values seem to be some indication of the productivity. Examples of the application of soil analyses are described.

Geochemistry is especially valuable in searching for shore-lines, sand lenses, and other stratigraphic traps. It seems that the geologist should find areas likely to yield stratigraphic traps, and then the geochemist can locate oil itself relatively cheaply.

G. D. H.

1067.* New Discoveries may Change Output of Illinois Fields. H. F. Simons. *Oil Gas J.*, 20.6.40, **39** (6), 17.—The Trenton limestone has been shown to be productive at Centralia at depths of about 4032 ft. After acidizing, it gave 113 brl. of oil in 16 hr. If this declines as rapidly as the Devonian production, much better wells will be required to induce drilling to this deeper horizon.

The Trenton is productive at Dupo in Illinois, where it has yielded 1,000,000 brl. since 1928. This field covers 670 acres, and the Trenton at a depth of about 600 ft. is highly permeable. The wells make much water, and now average only 4 brl. of oil/day. The Westfield and Waterloo fields also give Trenton oil, and the Trenton is productive in Michigan and North-west Ohio–North-east Indiana. The latter area has had large wells.

At the present time 40% of the Illinois production is from the Devonian.

G. D. H.

1068.* Red River Counties Spurred by New Discoveries. D. Dalrymple. *Oil Gas J.*, 20.6.40, **39** (6), 20.—A few weeks ago the Cumberland pool was discovered in Oklahoma, and has led to great activity in the southern part of the State. The discovery was preceded by geological and geophysical work, and shallow tests which had oil-shows. Oil was eventually found in the Tulip Creek sands at 4952 and 5088 ft. The daily potential was 4542 brl., and 25,000,000 cu. ft. of gas was gauged. Some 250,000 acres have now been leased in this region. The nearest pipe-line is 15 ml. away.

North-west of Madill a wildcat has found 6,000,000 cu. ft. of gas at 1120 ft. Wells are to be drilled in Atoka county, and others are under way in Cotton, Comanche, Stephens, and Tillman counties. Geophysical, geological, and geochemical work is being carried on in the Red River valley.

Oil has been known for some time in the Enos, Isom, and Kingston pools of Marshall county, and comes from depths of 400–500 ft. G. D. H.

1069.* Drilling Activity in 1940 Approaches 1937 Peak. W. V. Howard. *Oil Gas J.*, 20.6.40, **39** (6), 25.—Completions may amount to 32,000 in U.S.A. in 1940, for total completions were 18·4% ahead of last year and drilling operations 17·8% more numerous than on June 1st, 1939. The bulk of the increase is in the eastern area, Illinois, Kansas, California, and coastal Louisiana. The drilling activity of 1939 and 1940 is compared in tables.

Arkansas, North Louisiana, and Eastern Texas show the greatest decline in activity of all the major producing areas. G. D. H.

1070.* Steady Expansion in all Phases of Kansas Oil and Gas Operations. D. Dalrymple. *Oil Gas J.*, 27.6.40, **39** (7), 28.—Since 1860 more than a billion barrels of oil have been recovered in Kansas, and more than 400 oil and gas pools have been developed. In estimated reserves Kansas is the fifth state, and in daily average production it is sixth.

The history of the development of oil production in Kansas is described briefly. From 1905 to 1910 the annual output of oil fell from 4,250,000 brl. to 1,128,000 brl.,

in consequence of big discoveries in Oklahoma. Extensive developments raised production to a peak of 45,450,000 brl. in 1918, a figure which was not surpassed until 1934. The shoestring sands were developed after 1918, and in 1922 South-west Kansas entered the picture. The Western Kansas campaign continued from 1923 to 1937, when a new high of 70,835,000 brl. was reached under strict proration. A decline followed as a result of developments in Illinois.

A table gives the annual production since 1889. G. D. H.

1071.* Central Kansas Uplift has Several Prolific Pays. E. A. Koester. *Oil Gas J.*, 27.6.40, **39** (7), 50.—The oil- and gas-fields of the Central Kansas Uplift are on a buried subsurface feature. It is a broadly arched feature of pre-Pennsylvanian rocks, involving pre-Cambrian. Over much of the area the Arbuckle dolomite immediately underlies the Pennsylvanian, and the porous parts of the Arbuckle serve as the principal oil horizon. The Simpson gives a little oil. The Lansing–Kansas City (Pennsylvanian) limestones have given about one-fifth of the Kansas oil and the Arbuckle more than two-thirds.

Acid treatment of Lansing–Kansas City limestone beds has met with great success. The porous zones are lenticular and erratic. Many of the best pays appear to be only 5 ft. thick, and porosities may be 30–40%. A recovery of 6000–7000 brl./acre seems a reasonable expectation. The production is generally associated with a local high, and some of these are revealed in the surface Cretaceous beds.

Generally the best Arbuckle production is at the very top of the formation, but at times it is 20–30 ft. down, and sometimes there are several well-saturated zones. Apparently porosities of 20% are common. Acidization is beneficial, and most of the fields are under water-drive. The Arbuckle surface has some non-productive sinks. In general, oil production in the Arbuckle is associated directly with anticlinal structure. Recoveries of 7000–10,000 brl./acre are common.

The Topeka, Howald, and Tarkio limestones of the Pennsylvanian give a little oil, and the basal sand (Gorham sand), which ordinarily lies between the Arbuckle dolomite and the pre-Cambrian granite or metamorphics, has given considerable amounts of oil in some areas. There is minor production from pre-Cambrian granite and quartzite. G. D. H.

1072.* Kansas Oil Reserves Estimated at More Than 750,000,000 Brl. W. V. Howard. *Oil Gas J.*, 27.6.40, **39** (7), 52.—In the first four months of 1940 the estimated proven reserves were increased by 22,484,000 brl. A table shows the past production, estimated reserves, number of producing wells, and the producing horizons in the Kansas oil-fields. Other tables list the twenty-five fields with the largest reserves, the estimated ultimate recoveries of the twenty-five largest fields, and the total production of the twenty-five largest fields. G. D. H.

1073.* Kansas Operations by Fields. Anon. *Oil Gas J.*, 27.6.40, **39** (7), 58.—The oil-fields of Kansas are listed, together with the producing formation and its depth, the date of discovery, production to May 1940, daily average production, and the gravity of the oil. G. D. H.

1074.* Large Gas Reserves Ensure Many Years' Supply. J. H. Page. *Oil Gas J.*, 27.6.40, **39** (7), 69.—It appears that 15,000–25,000 gas wells, 100–2000 ft. deep, have been drilled in Eastern Kansas. Most of them are 800–1000 ft. deep. Gas occurs in sand, limestone, shale, coal, and chert, but mainly in the Bartlesville sand. A rough estimate of the reserves of Eastern Kansas gives 100 billion cu. ft.

The State's major gas reserves are, however, in the western part. Production is from the Permian lime and dolomite at Hugoton, at an average depth of 2700 ft. The original gas reserve is estimated at 13,736,375,000,000 cu. ft., of which 1·3% has been produced. At Cunningham gas is in the Viola, and the reserve is put at 80,000,000,000 cu. ft. The Medecine Lodge gas is in the Mississippi lime. At Lyons the Arbuckle lime gas production is on a buried structure revealed by seismic work. In McPherson county most of the gas is in the Mississippi lime, associated with oil.

Kansas has twenty-three natural gas pipe-line systems, with a combined mileage of 9165 ml. There are twenty-two natural gasoline plants with a capacity of 322,300 gal./day. G. D. H.

1075.* Stratigraphy of Kansas. R. C. Moore. *Oil Gas J.*, 27.6.40, **39** (7), 73.—The pre-Cambrian does not outcrop, but it has been penetrated by wells along the Nemaha granite ridge and on the Central Kansas Uplift. It consists of granites, metamorphics, and arkose, the last containing some oil on the flanks of the Central Kansas uplift. The Cambrian to Devonian rocks are essentially conformable, the older rocks being most widespread and the younger ones often restricted to basins. In this main group are limestones, dolomites, sands, and shales. The Mississippian is mostly limestone. The black Chattanooga shale is considered by some to be a source-rock.

The Upper Carboniferous and Permian rocks are separated from the older rocks by a major unconformity, on which the older truncated rocks outcrop. The Upper Permian (Cimarron) has red beds, dolomites, and anhydrite, in distinction from the marine beds of the Lower Permian and Pennsylvanian.

Trias may occur; there is some buried Jurassic in the west, and Cretaceous rocks are distributed throughout much of Western Kansas. The Cretaceous dips generally north-west and north. There is a thin veneer of post-Cretaceous beds in places.

G. D. H.

1076.* Eastern Kansas has Produced Bulk of State's Output. D. Dalrymple. *Oil Gas J.*, 27.6.40, **39** (7), 86.—The first commercial production may have been as early as 1886, and Kansas was established as an important oil-producing State when Eldorado was discovered in 1915. The peak in drilling activity was attained in 1918, when 3750 oil and gas wells were completed. Eldorado has now given 174,635,000 brl. of oil. Second to Eldorado in East Kansas is Augusta. Butler county has given more than 304,000,000 brl. of oil. Both Eldorado and Augusta are anticlinal and overlie the buried Nemaha ridge. Cowley is another highly productive county, oil coming from the Shawnee, Kansas City, Bartlesville, and Arbuckle horizons. Greenwood county has provided about 130,000,000 brl. of oil. G. D. H.

1077.* Mississippian Limestones in Central and Eastern Kansas. W. Lee. *Oil Gas J.*, 27.6.40, **39** (7), 102.—The thickness of the Mississippian limestones in Central and Eastern Kansas bears a close relationship to the geological structure, and hence to the occurrence of oil and gas accumulations. Limestones of this age are widely distributed, but they are absent over much of the major uplifts. These beds were deposited on a nearly flat surface of Chattanooga shale, gently folded, and then eroded. The pre-Pennsylvanian folding produced pronounced anticlines. 18,000–20,000 ft. of Cherokee and earlier Pennsylvanian rocks were laid on top of the eroded Mississippian. However, some parts were not always submerged, and so porous parts were developed in the limestone and residual chert left on the surface.

Pre-Mississippian folds seem to trend north-west. The original folds of the Mississippian rocks run north and north-east. North-easterly trends predominate in the later folding. Towards the Nemaha ridge there is a tendency to *en echelon* secondary anticlines.

Nearly all the fields which produce from anticlines are underlain by thin sections of Mississippian. The producing horizons of the Mississippian seem to be independent of the stratigraphical position, and dependent solely on the porosity. G. D. H.

1078.* Forest City Basin Prospects Improved. D. Dalrymple. *Oil Gas J.*, 27.6.40, **39** (7), 107.—Oil has been found in Jefferson county in the Kansas sector of the Forest City basin. The initial well is small. Two shallow oil pools have been opened in Johnson county on the south flank of the basin, and there are six gas pools. Oil has been discovered in Richardson county, Nebraska, while there has been much leasing in Brown county, Nebraska, and also in Atchison, Doniphan, Douglas, Jackson, Jefferson, Johnson, Leavenworth, Nemaha, Osage, Pottawatomie, Shawnee, Wabaunsee, and Wyandotte counties of North-east Kansas.

West of Topeka a wildcat was abandoned at 2720 ft. in water in the Wilcox. In Johnson county oil was found in the Squirrel and Bartlesville sands in the Gardner pool and in the Bartlesville 2½ ml. south-west of the O.K. discovery. The Arbuckle failed to give oil in tests in Douglas, Atchison, and Jefferson counties. Wildcats to the Bartlesville sand and Mississippi lime in North-east Kansas were unsuccessful. These failures were countered by a success late in 1939 near Falls City.

The position is viewed favourably, for most of the formations which produce oil

elsewhere in Kansas are present in the Forest City basin, as are many of the strata which are productive in Illinois. There are comparable structures also. Many of the deeper wells have had good showings of oil and gas, but few of the tests have been drilled on sound geological or geophysical data, or with modern equipment.

G. D. H.

1079.* One-fourth of Kansas' Area Leased for Exploration. Anon. *Oil Gas J.*, 27.6.40, **39** (7), 118.—In the first four months of 1940 it is estimated that major oil companies leased 100,000 acres, mainly on or bordering the Central Kansas uplift. Cowley county is another favoured area. There was a big leasing boom in 1928-1930, a decline, and then a revival in 1937, when about one-quarter of the State was under lease. At that date the Central Kansas uplift, the western flank of the Dodge City basin, and the Salina basin were the foremost areas of leasing.

A table gives the approximate acreage of land leased by major companies in the more active western and central counties in 1938 and 1939. G. D. H.

1080.* Methods of Correlation in the Geology of Petroleum. O. L. Bracaccini. *Bol. Inform. Petroleras*, Jan. 1940, XVII (185), 37–66.—This article discusses in detail the methods of correlation in the geology of petroleum—*i.e.*, correlation between continents in order to determine the chronological order to which various formations belong; correlation between the stratification of various provinces in the same continent; correlation within one province, and, finally, correlation between horizons within a small area—*e.g.*, an oil-field. Two methods are dealt with: the inorganic and the organic. H. I. L.

1081.* Concessions Granted by Portugal. Anon. *Bol. Inform. Petroleras*, Jan. 1940, XVII (185), 35.—Particulars are given of a concession granted to the Compania Ultramarina de Petroleos for exploitation of mineral-oil deposits in Timor Island in the region east of meridian 125° 50′ E. GW. There is no restriction as regards the period during which the concession may be held, subject to the decree dated 9th December, 1909, and provided the concession is marked out within a period of five years. H. I. L.

1082.* New Well by the Y.P.F. in Mendoza. Well Number L.3. at Lunlunta. Anon. *Bol. Inform. Petroleras*, Jan. 1940, XVII (185), 5–10.—On 22nd December, 1939, a new well was put in production, L.3., which appears to be as good as the best wells at Tupungato. Well is about 8 km. west of Barrancas, and 33 km. from Tupungato. The well gave an output of 43 m.^{3} at a depth of 2264 m. This result was obtained at a depth of only 13 m. drilled into the oil-bearing strata. The information is followed by a short note on the petroleum found in the Lunlunta zone. H. I. L.

1083.* Renewal of the Periods of Five Years Granted to the Y.P.F. for the Concessions held in the Province of San Juan and in that of Salta. Anon. *Bol. Inform. Petroleras*, Feb. 1940, XVII (186), 12–13.—Particulars are given of extensions to the period during which the Y.P.F. are allowed to work certain reserved areas in the two provinces above named. H. I. L.

See also Abstract No. 1185.

Geophysics.

1084.* Remote-control Seismic Instruments. P. M. Honnell. *Oil Wkly*, 10.6.40, **98** (1), 23.—Seismic exploration of many Gulf Coast areas is seriously hampered, if not rendered totally impossible, by transportation difficulties, and remote-control seismic instruments are designed to make feasible the exploration of otherwise inaccessible regions. This is accomplished by keeping all the heavier recording equipment at a fixed location, and moving the seismometers, shot point, and transmission lines. Remote-controlled line amplifiers are used to compensate for attenuation. Two-wire lines are preferable to single wires and ground returns, on account of the elimination of ground and stray current troubles. The remote amplifiers are rugged in construction, and their construction is described. A diagram is given of the recording circuit wiring, and the use of the control panel is briefly outlined. A remote-control shooting circuit is given.

The overall electrical characteristics and performance of the remote control system approximate very closely to those of more conventional recording systems, and its flexibility is a boon in areas difficult of access. G. D. H.

1085.* Direct Discovery of Oil Deposits Difficult. W. V. Howard. *Oil Gas J.*, 20.6.40, **39** (6), 27.—There seem to be certain difficulties in detecting at the earth's surface rays emitted by deeply buried oil, even if they exist.

Efforts have been made to locate oil by resistivity measurements, but, as electrical logging under much more favourable conditions shows, there is no certainty about such a method. The quantities to be measured are so small and the interpretation is so involved that direct discovery by gravitational methods seems impossible. G. D. H.

Drilling.

1086.* Colloid Chemistry of Clay Drilling Fluid. A. G. Loomis, T. F. Ford, and J. F. Fidiam. *Petrol. Tech.*, May 1940, A.I.M.M.E. Tech. Pub. No. 1201, 1–12.—The outstanding problems in the further development of rotary drilling fluids are considered in the light of the colloid chemistry of clay suspensions as we know it to-day. Mechanisms are proposed for the effect of various chemicals now in use to control the rheological properties of drilling muds. It appears that viscosity-reducing chemicals are adsorbed on specific surfaces of the clay particles and that they reduce the viscosity of suspensions by destroying the portion of the absolute gel strength which is attributable to adhesion between particles. On the other hand, salts are not adsorbed, but cause gelation and coagulation because of induced changes in the interparticle ionic atmospheres.

Comparison shows that sodium pyrophosphate is one of the most effective viscosity reducers. However, amongst the polyphosphates the pyrophosphate which has the lowest molecular weight gives the least permanent effect, and as the molecular weight increases to the decaphosphate there is a corresponding increase in the permanence of the viscosity lowering. This behaviour suggests diffusion into the inner particle surfaces.

While both the elasticity and the mechanical strength of clay gels are destroyed by chemical treatment the initial gelling rate of muds in the completely de-gelled condition is not significantly changed.

On the basis of the detailed structure of clays as revealed by X-ray analysis, chemical formulæ are written for colloidal clay particles and utilized to explain most of the phenomena shown by clay suspensions. The assumption of edge-to-edge contact to form structures in clay colloidal systems is apparently in accordance with experimental facts. G. D. H.

1087.* Effects of Temperature and Pressure on Rheological Properties of Cement Slurries. R. F. Farris. *Petrol. Tech.*, May 1940, A.I.M.M.E. Tech. Pub. No. 1207, 1–14.—A thorough knowledge of the behaviour of cement slurries under elevated temperatures and pressures is necessary in order to solve properly the many problems presented in deep-well cementing operations. The high-pressure consistometer used in the tests measured the energy consumed in rotating a stirrer at a known rate.

Making comparisons in the above way, it was found that high pressure and high temperature singly or together accelerate the stiffening and setting of a cement slurry. At a pressure of 5000 lb./in.^{2} and at 180° F., most of the cements tested stiffen too rapidly to permit proper placement in a deep well. At the same pressure and 220° F. all the cements tested stiffen beyond the limit of mobility immediately. Agitating a slurry at high pressures after rapid stiffening begins is detrimental to the strength of the set cement. The point on the consistency–time curves where rapid stiffening begins should be regarded as the maximum recommended pumping time, instead of using any assumed viscosity or consistency limit, such as 40 " poises " as a " limit of pumpability." The practical solution of many of the present and future high-pressure and high-temperature cementing problems will probably be solved when cements are improved so as to permit the placement of a uniform, mobile, and good-quality slurry at any given practical high temperature and pressure. G. D. H.

1088.* Draw-works Shift Improves Rig-floor Conditions. E. Sterrett. *Oil Wkly*, 24.6.40, **98** (3), 21–22.—A greater derrick floor space has been obtained, with attendant decrease in hazards and increase in control of the well, by removing the draw-works entirely from the floor, setting the unit on a special foundation at ground level, and using skids firmly tied to buried anchorages through paired cables and turnbuckles.

In this revised plan of operation a cathead shaft alone is mounted above the floor level, with the vertical chain driving it enclosed on the driller's side. This mounting affords the driller close supervision of any lines being used on either end of the shaft, with consequent quicker stoppage in case of twisted or overrun line.

Other advantages are discussed. A. H. N.

1089.* Redrilling and Workover Programme in Humble Field. N. Williams. *Oil Gas J.*, 13.6.40, **39** (5), 61.—An old lease that has been supposed to be depleted and had been practically abandoned is being reclaimed for production in a workover and redrilling programme. In less than a year production has been restored to a point that profitable return is being made to operators, thus forestalling premature abandonment of the lease and adding to the ultimate recovery.

Plans of the company attempting the project call for going back into each well, in turn, which is considered to have further potentialities, first cleaning the holes and attempting to recomplete the wells in the same sand in which they had been productive, and then, if not successful in that, testing higher sands either by perforating liner or casing at successively higher levels or by whipstocking up the hole and sidetracking with a new hole to a prospective sand.

The paper is a record of the operations carried out. A. H. N.

1090.* Unitized Equipment Cuts Cost of Moving. D. H. Stormont. *Oil Gas J.*, 20.6.40, **39** (6), 46.—Through assembly of drilling equipment into highly unitized sections, each mounted on skids, and arranging the various units so that they may be set up or torn down with a minimum of time and effort, a drilling company has effected a substantial saving in the time required for moving one of its rotary rigs. The various sections are trucked from location to location without dismantling, and the derrick is usually left intact and skidded. This not only permits a saving in time and costs, but also acts to prolong the life of some equipment that sometimes is damaged each time the rig is dismantled.

In addition to the unitization features contained in the rig, effort was made towards incorporating certain safety features in the design, such as a device for automatically throwing the draw-works out of gear if the cathead rope starts piling up on the cathead.

The rig is fully described, and dimensions of major items are given. A. H. N.

1091.* Rotary and Cable Tools used in Kansas Drilling. H. F. Simons. *Oil Gas J.*, 27.6.40, **39** (7), 48.—Equal opportunity exists in Kansas for both rotary and cable tools, although the former drills most of the hole, whilst the latter is mainly used for completion. Speed of drilling gives the rotary rig a decided advantage in drilling to the pay zone, and it is for this reason that rotaries are used where there is competitive development. It takes approximately 15 days to rig up a rotary, drill the hole, and set the pay string on the average well of 3300 ft.

There have, however, been numerous advances in both methods in recent years. Portability and small holes are two of the most important problems at present. The trouble in cable-tool drilling is mainly occasioned by the caving formations, a black and blue shale at 2100–2400 ft. giving the greatest trouble. Caving is prevented to a certain extent by the addition of salt to the drilling water. A. H. N.

1092.* Economics of Slim-Hole Drilling. F. W. Heiser. *Oil Gas J.*, 27.6.40, **39** (7), 56.—Slim-hole drilling, having no other feature superior to methods used in the past, is warranted purely from a financial point of view. The total saving being effected in Kansas by the use of slim-hole drilling and lighter pumping equipment amounts to $12,000 over the conventional type wells using heavy-duty equipment, as was the practice two years ago.

The advent of slim-hole drilling into Kansas was in answer to a wide demand for

reduction in development costs that would make possible development of acreage which would not be commercially attractive with the usual development costs.

Despite the acute proration situation, Kansas drilling activity again shows a progressive increase; probably due, in part, to the successful application of slim-hole drilling. The introduction of lighter pumping equipment in slim-holes has not only reduced the initial cost to a minimum, but is also reducing operating costs.

A. H. N.

1093.* Rate of Penetration in Drilling. K. C. Slater. *Petrol. Engr*, June 1940, **11** (9), 47–48.—A general discussion is made of some of the factors recognized as important in their effect on the rate of penetration in rotary drilling. A study of well records shows that during the six-year period 1932–1938 the total increase in rate of penetration in a group of more than 500 rotary wells in different fields was 123·7%. The respective percentages contributing to the total increase in rate of penetration in this group of wells was reported as follows: personnel and equipment, 55·5%; rotating speed, 39·6%; and drilling fluid, volume, 28·6%. In these figures was included another factor, weight on bit, which was found difficult to evaluate separately. The percentages shown are merely intended to suggest the importance of the parts played by the several factors in increasing the rate of penetration in the group of more than 500 wells studied. It is presumed that in different localities the figures may be different, as the character of the formations being drilled is an important factor. (Cf. J. E. Brantly and E. H. Clayton, *A.P.I. Drilling and Production Practice*, 1939.)

A. H. N.

1094.* Deepening and Completing a Well in the Lisbon Field, Louisiana. Part 5. P. D. Torrey and F. H. Miller. *Petrol. Engr*, June 1940, **11** (9), 68.—In this exhaustive paper the descriptions given in the first four parts about every step undertaken in deepening and completing a certain well are continued with the same attention to every detail. The completion programme is continued by giving the testing of the remaining sands. Finally a summary of the completion programme is given with hints for similar operations in the future.

This part concludes with data and procedure for production tests. These tests give daily gas production during test and separated liquid characteristics in terms of accumulation, recovery and shrinkage, and solubility of gas. Graphs are reproduced and discussed.

A. H. N.

1095. Modern Drilling. W. C. Bailey. *California Oilfields*, Vol. 23, No. 4, April 1940.—The stated purpose of this article is to assist operators desirous of improving their drilling technique by explaining certain new ideas and mechanical advances made in methods of drilling during recent years.

Mention is made of a direct-acting hand pump designed for use where it is desirable to avoid steam pressures exceeding 250 lb. and yet to be in a position to deliver the desired quantity of fluid against the pressures encountered.

There is a new superheated steam generator, entirely self-contained, and mounted on steel skids for portability, which is an embodiment of the principle that increased output is obtainable by more effective use of heating surface and does not necessarily involve increased size and weight.

As regards general equipment, modern designers are agreed that this should incorporate as few units as moving facilities will permit. There is one highly unitized system designed to drill to 3000 ft. which utilizes two vertical two-cylinder variable cut-off steam engines for power. While drilling, one engine only is used to drive the rotary table and the other to drive the hand pump. One boiler is used to generate the steam.

The hydromatic brake is an example of new ideas which in a very short time have become almost standard equipment. It does not obviate the necessity of mechanical brakes, but used in conjunction with them it has decided advantages and affords an extra safeguard when handling great loads.

Power is generated in Californian oilfields most commonly by steam engines. There is, however, a tendency to employ the ordinary horizontal type of engine, while actually there is available a much more efficient type involving the use of a variable cut-off arrangement instead of a throttle valve for reducing power output. For fairly deep

drilling the internal-combustion engine utilizing gas, gasoline, or diesel oil is frequently employed. Hitherto it has been regarded as inferior to steam-powered outfits, largely owing to the unsatisfactory performance of any available clutch and reverse mechanism. Correction of this fault has, however, entitled this type of engine to be favourably compared with steam-operated units.

Another invention which has effected an enormous saving in time and money is the formation tester, which obviates the laborious practice of setting a string of casing whenever a formation has to be tested. This machine in effect utilizes the drill pipe as a temporary casing, and there are two types available: one depending on mechanical means to expand a packer against the walls of the hole, and the other depending on a previously prepared seat in the formations immediately above those being tested.

Potentialities of the Turbo drill, a new and completely different method of rotary drilling, the use of gravel packing and the employment of a column of dead oil instead of mud fluid are also discussed, among a variety of other subjects connected with modern drilling practice. H. B. M.

1096. Drilling in with Oil in Kettleman Hills Oilfield. F. C. Hodges. *California Oilfields*, Vol. 23, No. 4, April 1940.—Drilling mud, although almost invariably used in rotary drilling, has certain serious disadvantages. In partly depleted oil zones where pressures are comparatively low it tends to preclude complete recovery by clogging the interspaces in the oil sands: where pressures are exceptionally low it has been known entirely to prevent the entrance of oil or gas into the well.

Recently attention has been turned to the possibility of using oil as an alternative to drilling mud, and in this paper an account is given of routine experiments conducted by the Kettleman North Dome Association and the Standard Oil Co. of California in the Kettleman Hills oilfield.

Several major problems were encountered during the course of these experiments. In order to remove bit cuttings the stream velocity of the fluid column had to be increased. This could only be achieved by the injection of gas into the oil stream. Again, an oil–gas mixture, unlike rotary mud, is entirely lacking in wall-building properties, and the conditioning of the walls of the borehole presented considerable difficulty when this fluid was used.

Experiments with drilling equipment in accordance with conventional rotary tables proved unsatisfactory, and special equipment accordingly was more or less standardized.

The special equipment is installed after the water string is cemented and before the cement is drilled out. When the cement is drilled out and the water shut off is approved, the rotary mud is circulated out of the hole with water and the water replaced with 33–35° gravity oil. The gas is injected into the oil stream after the fluid leaves the pumps at a rate of approximately 200,000 cub. ft. per day. The North Dome Association employs a pressure of 1200 lb. per square inch and the Standard Oil Co. 900 lb. per square inch.

The sole reason for using oil instead of drilling mud is to secure better well completions, and thus increase production. Owing to the small number of wells drilled in with oil and the relatively short time they have been on production, it is not possible accurately to assess such increases. Nevertheless, conclusions based on comparison of maximum production rates attained during the early lives of these wells indicate that increased productivity is obtained from wells completed in this way. Tabulation of data concerning seven wells completed by using oil and injected gas, and wells using rotary mud completed at about the same time, in similar structural positions and in the same locality and zone, shows that six of these had a greater production than those drilled with mud. Three of them definitely had no advantages in pressure or producing conditions, indicating that the increased maximum production rates could be attributed to the method of completion. H. B. M.

1097. Drilling. C. R. Dale. U.S.P. 2,203,720, 11.6.40. Appl. 10.12.34. Apparatus for detecting water intrusion into boreholes utilizing a photo-electric cell and a microammeter.

J. J. Jakosky and P. B. Lyons. U.S.P. 2,203,729, 11.6.40. Appl. 19.11.38.

Method and apparatus for use in determining the geologic nature and characteristics of a formation traversed by a borehole.

C. H. Johnson. U.S.P. 2,203,730, 11.6.40. Appl. 27.1.39. Method and apparatus for determining the strike and dip of subsurface strata traversed by a borehole.

H. D. Sandstone. U.S.P. 2,203,747, 11.6.40. Appl. 20.9.37. Laminated disc drill bit.

T. H. Stancliff. U.S.P. 2,203,846, 11.6.40. Appl. 13.12.38. Drill bit with side cutters.

G. A. Lowrey. U.S.P. 2,204,091, 11.6.40. Appl. 13.2.39. Inside pipe-cutter, adapted to cut by rotation pipes inside a well.

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R. E. O'Donnell. U.S.P. 2,204,378, 11.6.40. Appl. 8.6.39. Open-hole packer for temporarily securing and sealing a conduit in a well.

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H. E. Grau. U.S.P. 2,204,586, 18.6.40. Appl. 15.6.38. Safety tool joint.

L. F. Baash. U.S.P. 2,204,545, 18.6.40. Appl. 17.12.38. Rotary-table assembly.

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C. Brendel. U.S.P. 2,204,657, 18.6.40. Appl. 12.7.38. Roller bit.

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C. White. U.S.P. 2,204,713, 18.6.40. Appl. 20.5.39. Portable derrick fixed on a mobile base, attached to a lorry.

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J. F. Chappell. U.S.P. 2,204,844, 18.6.40. Appl. 5.12.38. Drilling and coring apparatus having a reciprocating inner bit within a rotating drill pipe.

G. F. Le Bus. U.S.P. 2,204,938, 18.6.40. Appl. 4.5.38. Cable and rope winding device.

G. Tipter. U.S.P. 2,205,022, 18.6.40. Appl. 27.12.37. Bore-hole direction tester using heavy pendulum, a record sheet and a magnetic compass.

E. B. Hall and A. L. Armentrout. U.S.P. 2,205,119, 18.6.40. Appl. 17.4.39. Method of setting drillable liner in wells, using cement.

J. H. Burt. U.S.P. 2,205,238, 18.6.40. Appl. 19.6.39. Cable-tool bit.

J. S. Morgan and J. D. Spalding. U.S.P. 2,205,269, 18.6.40. Appl. 1.3.37. Rotary machine.

C. C. Scharpenberg. U.S.P. 2,205,697, 25.6.40. Appl. 6.5.38. Tool joint for well drilling fitted with groove of reduced thickness so that the sleeve is as flexible as the pipes it couples.

D. B. Monroe. U.S.P. 2,205,729, 25.6.40. Appl. 1.12.38. Inclinometer utilizing a plumb bob. A. H. N.

Production.

1098.* Steady Flow of Gas–Oil–Water Mixtures through Unconsolidated Sands. M. C. Leverett and W. B. Lewis. *Petrol. Tech.*, May 1940, A.I.M.M.E. Tech. Pub. No. 1206, 1–9.—The apparatus used was similar to that employed by Leverett in investigating the flow of oil–water mixtures through unconsolidated sands. Facilities were provided for determining the oil, gas, and water contents of the sands, as well as the rates of flow. It was found that the relative permeability to water was fixed by the water saturation alone and was not affected by the introduction of an additional non-aqueous phase. The relative permeability to gas in three-phase flow is slightly less than would correspond to the same gas saturation in two-phase flow, but the relative permeability to oil varies in a more complex manner, being in some regions less and in others more than for the same oil saturations in two-phase flow. The isoperms for all components are independent of the viscosity of the oil phase. The presence of appreciable amounts of all three phases in a flowing stream in equilibrium with the fluid in the pore space is limited to a relatively small region of pore composition.

It appears that the presence or absence of connate water is not an important factor in the recovery of oil by the gas expansion mechanism. This was confirmed by direct experiment. The unrecovered oil will vary inversely as the connate water saturation.

The mechanism of three-phase flow is discussed. G. D. H.

1099.* Handling of High Pressures at La Gloria, Texas, Field. H. F. Harris. *Oil Gas J.*, 13.6.40, **39** (5), 58–59.—Encountering high gas pressures results in one of the main types of difficulties in drilling deep wells on the Gulf Coast, and the same pressures often cause considerable trouble when a well is completed and attempts are made to produce it. This has led in some cases to unusual well installations, well heads, and separators in an effort to obtain production from the well both economically and efficiently. The paper describes the arrangements of chokes and heaters for expanding the gas, braden-head installations, high- and low-pressure separators, and recording orifice-type meters. Data of pressure readings are given showing shut-in pressures on the wells from 2490 up to 3650 lb./sq. in., tubing pressures while flowing ranging from 1500 to 2000 lb./sq. in., etc.

The paper is descriptive. A. H. N.

1100.* Metals in Production. W. L. Nelson. *Oil Gas J.*, 13.6.40, **39** (5), 70.—This is the sixteenth of a series of articles pertaining to the use of metals and alloys in the petroleum industry, and deals with pull rods, meter parts and instruments, pumping jacks, speed-reducer gears and parts, sling or construction chain, field tanks, and water-disposal lines. The percentage compositions in terms of carbon, nickel, chromium, molybdenum, copper, and "others," as well as the yield point, elongation in 2 in., and Brinell hardness, are given for various metals and alloys used in these parts. The materials include carbon and manganese steels, Monel metal, nickel silver, bronze, brass, invar, etc.

Notes are also given regarding the use and care of these metals in their respective rôles. A. H. N.

1101.* Wider Spacing Places Kansas on more Profitable Basis. H. F. Simons. *Oil Gas J.*, 20.6.40, **39** (6), 34.—Granting of full consideration to acreage up to 20 acres in

the allocation of production has permitted Kansas operators to increase their daily revenue and total income per well without an increase in investment.

A short description is given of Kansas fields, their mode of development and spacings. Costs are given for lease acreage and for drilling and developing activities; a good average figure for well investment appears to be $22,500, to which $4500 must be added for production equipment. Other financial and economical data are given in evaluating the profits and loss of wells in these fields.

To improve the balance the operator must increase the per-well income and/or decrease the costs. Of the three methods of increasing the income per well, two, a higher price/brl. and a greater market, are beyond the powers of the operators. Wider spacing will increase the per-well allowable providing acreage is given consideration in allocating the production.

Costs of wells have been decreased in Kansas by drilling of smaller holes, use of smaller casing and surface equipment, and wider spacing of wells. The latter results in more oil/day and more total recovery/well.

The paper is an explanation of these statements in terms of factual records of results already achieved and by a study of the various fields adopting these principles.
A. H. N.

1102.* Recognizing and Overcoming Gas Lock in Pumping Wells. T. P. Sanders. *Oil Gas J.*, 20.6.40, **39** (6), 43.—Gas lock can be recognized by low pumping efficiency, provided that enough is known of the particular well to eliminate other possible causes for poor recovery, such as insufficient pump submergence, worn working parts, leaking pump-valves or tubing, or loss of plunger stroke due to rod stretch or tubing movement.

Nine methods are outlined for overcoming gas lock: including the use of a "gas valve" at the bottom of the plunger; correcting the pump spacing; using an oversized or stream-lined standing valve; slowing down the pump; using smaller plunger and pump than the existing ones; using a gas anchor; maintaining minimum pressure on the casing head; allowing sufficient space around the pump and tubing to permit free escape of gas; and drilling a pocket or sump hole into the barren rock below the oil horizon.
A. H. N.

1103.* Draw-down Method of Taking Potentials in Kansas. M. Brown. *Oil Gas J.*, 27.6.40, **39** (7), 63.—The theory and practice of draw-down method of taking potentials is discussed. It is concluded that this method of measurement is not only a yardstick of well comparison, but also is a means of studying the action of the reservoir and the underground equipment. So impressed are certain major operators that they are purchasing the instruments not for state potential determinations, but for their own private periodic investigation of their wells' performances.

Production practice has been greatly improved by the adoption of the draw-down method of taking potentials. In addition to the scientific information which it makes available, economic and reservoir waste is reduced to a minimum.

Careful study of the collective well records on any lease is essential to find the best, and often least expensive, equipment that will satisfactorily handle the specific production problem in hand. Changes in rates of withdrawal in daily operation can often be made which will show economy in amounts of water handled, or the records may indicate necessary tubing changes in their depths or size, or recommend more economical gas–oil ratios to be obtained.
A. H. N.

1104.* Water-Flooding in Kansas. P. Reed. *Oil Gas J.*, 27.6.40, **39** (7), 77–78.—The history and operation of the main water-flooding projects in the State of Kansas are outlined. Water is pumped from a river, in most cases, by centrifugal pumps and treated with sodium aluminate, lime, copper sulphate, and chlorine. After passing through filters, the water is pumped to intake wells. Injection pressures vary from 300 to 750 lb./sq. in. Successful flooding is conducted in this area with the injection of 10 brl. of water/1 brl. of oil. Wells are drilled on a five-spot pattern with spacing of 440 ft. (north and south) and 330 ft. (east and west). Coring is important in furnishing data for the development programmes. A few wells are flowed, but many wells are pumped.
A. H. N.

1105.* Most of Kansas' Output Comes from Water-Drive Fields. E. A. Stephenson. *Oil Gas J.*, 27.6.40, **39** (7), 79.—While many of the problems of production engineering are not encountered in Kansas, such as heaving shales and extremely high formation pressure, together with the completion and operating problems which accompany these pressures, a number of developments have become almost characteristic of Kansas. The more important of these characteristics are: (1) slim-hole drilling; (2) increased portability, compactness, and unitization of machinery for drilling purposes; (3) trend towards other production methods than by the use of ordinary reciprocating pumps; (4) increasing recognition of the value of edge- and bottom-water as agents in oil recovery; (5) general acceptance of the possibility that in water-drive pools wide spacing, within certain limits, is not only economically sound, but may also result in as large per-acre recoveries as can be obtained from the long-established " rule of thumb " 10-acre plan; (6) widespread use of draw-down methods, sonic reflections, for the measurement of potential; and (7) increased use of wells drilled for special purpose of salt-water disposal. A. H. N.

1106.* Kansas Conservation. T. A. Morgan. *Oil Gas J.*, 27.6.40, **39** (7), 113.—The effects of proration measures on the oil industry of the State of Kansas are discussed in a general manner. A. H. N.

1107.* Kansas Wells Benefited by Slower Withdrawals. H. F. Simons. *Oil Gas J.*, 27.6.40, **39** (7), 114.—Faced with a declining market for the past 3 years and a steady diminution of the daily average production, operators in Kansas have had to rely on a reduction in the operating costs to keep their businesses profitable. Practically all of the producing practices in the area are dictated by that necessity, including reduction in size of casing, tubing, surface equipment, acidizing costs, oil treatment and water disposal, and the prevention of corrosion and unnecessary water encroachment. These items are discussed.

Since the method of taking potentials was changed, the necessity of large pumping equipment has been eliminated and it has been found that the wells equipped with small units and operated over a longer period per day have had less water trouble. The method has not only halted water encroachment, but actually reduced the quantity of water and increased that of oil produced from a well. A. H. N.

1108.* Proper Selection of Prime Mover Leads to Pumping Economy. T. P. Sanders. *Oil Gas J.*, 27.6.40, **39** (7), 124.—The assumption that the horse-power of a prime mover should correspond to the nominal horse-power-rating of the pumping unit may lead to a poor selection. Actually the size of prime mover needed should be determined directly from the horse-power required at the polished rod, allowing a suitable factor for overall efficiency of the pumping unit. Ageing of the field results in increased average polished-rod load. It is therefore recommended that a prime mover should be installed capable of pumping fluid of the weight of water from the total depth of the well at the desired rate with no assistance offered by fluid level.

A formula, based on the study of a great many dynamometer cards—*i.e.*, polished-rod horse-power—is given to calculate the required horse-power to pump fluids at certain rates. Surface equipment efficiency appears to be 85%. Other items, such as crookedness of holes, require more power. A. H. N.

1109.* Optimum Spacing of Dolomite Acreage in the Texas Panhandle. P. J. Jones. *Oil Wkly*, 10.6.40, **98** (1), 28.—*Paper presented before American Petroleum Institute.* The author presents data showing that ultimate recovery within 10- to 20-acre limits on the Panhandle dolomite is independent of spacing. The basis for calculation is the following set of representative physical data: an allowable of 20 brls./day/well, irrespective of spacing; 365 operating days/year; an economic limit of 3 brls./day; an investment of $22,500/well; an operating cost of $1800/well/year, including taxes; a one-eighth royalty; and interest at 6%.

It appears that, on an average, optimum spacing of the dolomite Panhandle acreage is 18 acres/well at the present income of $0·98/brl. of oil produced. As the recovery available from eighteen average acres is 136,000 brls., and as per acre recoveries vary,

the more general conclusion reads thus: Optimum spacing on the dolomite trend is 1 well/136,000 brls. of recoverable oil. This conclusion does not hold if the allowable is not on a per well basis. A. H. N.

1110.* "Sand Squeezing" by Air Pressure. F. R. Cozzens. *Oil Wkly*, 10.6.40, **98** (1), 42.—"Sand squeezing" is a process used to reclaim oil reserves which have been pushed back into the sand by former pressuring. Porous sands are broken occasionally by harder streaks, and it is reasonable to assume in certain cases that air under pressure in a repressuring project has pushed the fluid in porous channels and dammed it up against the hard barriers.

"Sand squeezing" consists, then, of pumping air under pressure through two wells near the hard streak, and thus forcing the oil back to the central porous streak, where wells are pumped vigorously to lift the oil thus reclaimed. The pressure of the air in each of the intake wells should be as nearly equal to the other as possible. By this method thousands of brls. of oil are often reclaimed from stretches of sand less than a mile in length. A. H. N.

1111.* Paraffin Removal Economically by Electrical Process. B. Mills. *Oil Wkly*, 17.6.40, **98** (2), 15–17.—A new method for removing paraffin deposits, by heating the tubing electrically, has been used with sufficient success to warrant installation of permanent units on thirty pumping wells over a 2-year period.

The tubing hanger is insulated from the casing-head by an insulating medium shaped to fit the heads, whilst the tubing is insulated from the casing by conical-shaped insulators placed around the couplings to hold the tubing in spaced relation ship to the casing. A spring contact is set at the required depth to complete the circuit between the tubing and casing. A d.c. or a.c. of high amperage and comparatively low voltage is introduced by connecting the input terminal to the tubing and the return to the casing. Heat is generated in the tubing, rather than in the casing, because of the smaller diameter of the tubing and its consequent greater resistance to the current.

The unit is described and illustrated in detail. A. H. N.

1112.* To Try Pressure Maintenance on Small, Shallow Tract. F. B. Taylor. *Oil Wkly*, 17.6.40, **98** (2), 18–20.—Of the more than 200 pressure-injection operations in the upper Mid-Continent area, only a small number are pressure-maintenance type of projects, by far the majority being some type of repressuring work. Of these few one, the most recent to get under way, departs from the ordinary in a number of respects. Foremost in interest is the apparent small quantity of productive acreage involved. Moreover, the project is not expected to increase profit until a more advanced stage is reached. As the project at the present time is only in its initiative stage, the paper analyses only the primary elements towards getting the work under way. However, it is already established that the decision to maintain reservoir pressure in order to increase the ultimate recovery appears to be well founded. A. H. N.

1113.* Waste in Oil Reservoirs. S. F. Shaw. *Oil Wkly*, 17.6.40, **98** (2), 21.—In this long paper the author finds it difficult to define exactly oilfield waste. There are losses of oil which are unavoidable; oil remaining currently unrecovered in the reservoir that will be recovered at some later time. It is hard to decide how much of this is "absolute waste," a term applied to such losses as oil running down creeks and not recovered, oil burned in wells that catch fire, etc.

The reasons why early primary-recovery percentages in relatively shallow fields were low are detailed, and it is also shown that in reality the recoveries were underestimated. However, it is not correct to assume that oil is wasted when it is allowed to remain in the reservoir because it is unprofitable at a given time to extract it. Secondary extraction methods have increased the ultimate recovery in certain fields by a considerable percentage. On the other hand, secondary recovery methods are sometimes shown to be unprofitable due, perhaps, in most cases to the fact that the price received for the oil is lower than has been expected. Thus higher ultimate recovery is not the only criterion that controls the action of the operator.

It is pointed out that for the last 15 years the kind of waste as oil overflowing from tanks, escape from leaky pipe, evaporation from stock tanks, burning of oil unacceptable to pipe-line companies, blowing out of wells and consequent escape of oil and gas in immense quantities, improper handling of wells, etc., has been practically eliminated. The author asserts that since 1926 he has not seen any appreciable evidence of avoidable waste in the Americas or Europe, despite statements in the Press to the contrary. Where wild wells blew out, the owners were more anxious than anybody else to put them under control.

Increase in ultimate recovery brought about by natural water drive, by restriction of production, by attempts to change gas–oil ratios without regard to the conditions in the reservoir, is of doubtful benefit. Cases are cited to illustrate the statement. In certain fields, where the formation is very porous and permeable, and where production at maximum capacity does not increase the gas–oil ratios, it is believed that ultimate recoveries are raised if the fields are produced at maximum capacities. Cases are cited to explain this and other statements in detail. A. H. N.

1114.* Skid-Mounted Pump Units Move from Well to Well. Anon. *Oil Wkly*, 17.6.40, **98** (2), 44.—Details are given of skid-mounted light-weight pumping units. In considering the economics of the practice, a number of units that have been in steady service for some months have shown that the wear is not unduly high. However, the loads must be watched and the machine must not be over-taxed. A. H. N.

1115.* Water Flood Restores Profit to Stripper Operations. J. C. Albright. *Oil Wkly*, 24.6.40, **98** (3), 15–20.—Records are now available to show that a scientifically conducted water flood will recover more oil within 4 or 5 years than has been possible to produce from many sands during their entire previous lives. A typical field is studied in some detail, describing the wells, the surface fittings, sources of water supply, and methods of its injection and measurement, tanks, power, units etc.

The quantity of oil which may be recovered from a given sand obviously depends on the quantity of residual oil in the sand at the time the flood was begun. Methods in use prior to a water flood usually depleted the sand of its gas and attendant lifting power, and may recover as much as 30–35% of the amount of oil originally in the sand when the well was first drilled. The percentage of oil recovered from the residual quantity in the sand at the beginning of water-flooding may also vary, but when a flood has been started, the wall of water should be continued at a constant pressure and input rate. Otherwise, the water may flatten out in the vertical section, and when started again could cause excessive trapping so that oil may never be brought to the surface. A. H. N.

1116.* Effects of Rod Vibration on Dynamometer Card. K. N. Mills. *Oil Wkly*, 24.6.40, **98** (3), 23.—It was noticed for a considerable time that dynamometer cards obtained for sucker rods working at low speeds were very similar to the ideal card in general. On increasing the pumping speed, from 6 to 11 strokes/min., the shape was distorted to a great extent, due to vibrations being set up in the rods.

The system may be represented by a long rod, fixed at one end, and the other end of which is subjected to suddenly applied force. By eliminating the cases of higher frequencies—*i.e.*, assuming the damping effect of the oil to allow only the lowest possible frequency to operate—the equation of frequency of vibration is reduced simply to $f = \frac{V}{4l}$, where f = frequency, in cycles/sec., V = velocity of sound in the material of the rod string, in ft./sec., and l = length of rod string in feet. Practical tests prove this to be very nearly true. Summations of vibrations of various amplitudes and in or out of phase with each other are discussed generally.

All vibrations in the rod strings emanate from the opening and closing of the travelling valve. Practical proof is given. The rod string in a pump pumping gaseous fluids will have a vibration set up in it once every cycle, at the time the load is taken up by the string—*i.e.*, when standing pump opens. When the same string is used in pumping a dead fluid there will be two vibrations, one when the load is taken up by the string and one when the load is taken off it. The amplitude in the case of pumping dead fluids will, therefore, be greater than when pumping gaseous fluids.

The vibrations as recorded by a surface card will be approximately half a period out of phase with those recorded at the pump due to time lag of forces applied to the ends of a string. The time of the upstroke as compared with the downstroke will further complicate the diagram.

Finally, resonance conditions are studied with the aid of diagrams built from simple assumptions to yield different types of dynamometer cards showing one or more waves either on the upstroke or downstroke portions of the card only or on both. For simplicity, only boundary conditions are studied, but these may be used as guides for more complex ones. A. H. N.

1117.* Sand Pack Solves Well Sanding Problem. C. Johnston. *Oil Wkly*, 24.6.40, **98** (3), 34.—A well, drilled on a salt-dome flank and completed in an unidentified sand, gave severe trouble with very fine sand which, it appeared, was almost impossible to exclude. After setting ten unsuccessful screens, an eleventh and new type one was tried and found successful. This consisted of inner and outer shells of specially fabricated screen pipes containing carefully proportioned packing of sand in the annulus. Details are presented. The well is still producing, in June 1940, the same amount of fluid as it flowed when originally equipped with the screen on 14th October, 1939. A. H. N.

1118.* Permian Basin Present Situation and Outlook. H. C. Wiess. *Oil Wkly*, 1.7.40, **98** (4), 14–16.—In discussing current problems confronting West Texas operators, the author also presents an interesting review of the situation existing in many other parts of the U.S.A. It is asserted that continuation of an active drilling campaign during a time when market demand has failed to gain appreciably has resulted in a steady decline in per well allowables until a much longer investment payout rate has been created.

Operators are urged to consider carefully the rate and circumstances under which additional drilling investments should be made, and the necessity is advocated for wider well spacing and careful development generally in order to insure profitable operations. The alternative of sound production engineering resulting in a long period of profits is a short period of boom prosperity followed by complete collapse.
A. H. N.

1119.* Charts Simplify Many Pumping Problems. B. Altman. *Oil Wkly*, 1.7.40, **98** (4), 17–23.—The principles involved in specifying the capacity, horse-power, and other characteristics of an oil-well pumping unit required to lift a certain quantity of oil per day are outlined. A simple chart gives the first case of pumping problem where ideal conditions only are assumed.

A second and more accurate chart is reproduced by means of which the number of strokes per minute and length of stroke may be determined for most economical lifting of a quantity of oil with a pump of any efficiency between 60 and 100%. Further, six charts are given for calculating the combined rod movement and tubing stretch for various sizes of rod and tubing combinations. Another graph is designed for determining the static weight of wells for any set of constants of plunger diameter, depth of well, rod diameter and oil gravity. Tables give impulse factors, and a final chart is unitized for calculating torques necessary to pump a well under certain conditions. A. H. N.

1120.* Pressure Constants Used to Fix Potentials of Flowing Wells. F. B. Taylor. *Oil Wkly*, 1.7.40, **98** (4), 29.—Certain advantages accrue from the use of a restricted flow-pressure-drop relationship for determining actual productivity of wells that do not result from other methods. A full open flow of a producer results in considerable immediate production, and this calls for lease storage or disposal far in excess of normal requirements. By unrestricted open flow of a producer, there is danger of producing a water cone, gas cone, or in some manner bringing about a physical injury to the producing area. Restricted flow tests obviate both dangers. In addition, the pressure decline test can be exactly duplicated a month or a year later, to establish accurately any change or rate of change in the productive ability of a well or field. Correlation through the point at which a well no longer flows to draw down potentials

is possible, so that the change from one method to the other is bridged by fundamental data rather than by supposition. Finally, pressure tests do not require expensive and extensive equipment solely for testing purposes.

The theory of pressure decline tests is very briefly outlined. Two methods are described for determining the index. In general, the well is brought to a steady condition before the test. A pressure bomb is lowered and the pressure is recorded at various depths to determine practically the depth correction in recorded pressures. The well is then made to flow under several rates of production, the maximum being less than 50% of the estimated maximum possibility, and the pressures are recorded under certain steady conditions. By calculation or plotting the result a production index is found.

The paper gives actual requirements and details and shows a specimen calculation by one of the two methods. A. H. N.

1121.* Gravel-Packing Injection Wells for Recycling Gas. H. L. Flood. *Petrol. Engr*, June 1940, **11** (9), 53–54.—Before putting injection wells into operation, in condensate reservoirs, they are under-reamed and gravel-packed in order to obtain low-injection pressures when returning large volumes of gas. A diagrammatic sketch and a detailed account describe the operations involved and general procedure followed in one particular field, where the well is gravel-packed as a routine job in the completion process and not as a separate step taken subsequently as a remedial measure.

After a discussion of the advantages expected to be obtained by using such a procedure in reducing injection pressure requirements generally, it is concluded that data available up to the present are not sufficiently abundant to assess the value of under-reaming and gravel-packing. The gravel-pack is, however, considered, in the least, a worth-while insurance against contingencies that may impair the efficient operation of a gas-injection well. A. H. N.

1122.* Multiple Production from Several Zones Controlled by Bottom-Hole Chokes. W. A. Sawdon. *Petrol. Engr*, June 1940, **11** (9), 109–110.—Allocation of production from the Montebello field, California, is made according to the gas potential of a well when it is completed. Thus with the gas allowable for a well established, the operator strives to produce the maximum of oil with that allowable gas production. As the field has a multiplicity of producing horizons, some rich in gas and poor in oil and others *vice versa*, gas is taken from one zone and passed through chokes to control it and used to lift oil from a deeper formation richer in oil and poorer in gas.

Three types of installations are reproduced diagrammatically and their operations are discussed. The choke is run into the well with running tool jars and sinker bar on a small wire line. When it is in position in the landing nipple it is automatically locked there, and the running tool, sinker bar, and wire line are withdrawn. The choke is removable with a pulling tool, which is also run-in on a wire line. A. H. N.

1123.* Behaviour of Oil and Gas under High Pressures and Temperatures. Part 1. H. T. Kennedy. *Petrol. Engr*, June 1940, **11** (9), 117.—Working on the thesis that analysis of high-pressure gas–oil equilibria may indicate relative position of a well in the reservoir, and thus determine future drilling and proper methods of production, the author details the simple gas laws and then moves on to high-pressure phenomena, and in particular to retrograde characteristics of mixtures of oil and gas under such conditions.

A capillary tube was partly filled with oil of the same concentration as occurred in a particular well under study, and the remainder of the space was filled with gas of the same composition as occurred in the same well. The capillary was sealed and the temperature and pressure were raised to values obtaining in the well. The oil completely disappeared into the gaseous phase. As a control tube containing only oil did not show evaporation of oil without the gas under the same temperature, it was concluded the well penetrated a gas cap under " retrograde " conditions. Wells lower down the structure are producing heavy oil with normal gas–oil ratios, thus justifying the conclusions.

This was in 1930, and is believed to be the first demonstration of wells producing " distillate " oils. A. H. N.

1124.* **Electric Generating Plants on Kansas Producing Properties.** R. A. Axe. *Petrol. Engr*, June 1940, **11** (9), 132.—Before the adoption of proration regulations in Kansas, the lowest operating costs had been obtained by installing pumping equipment that would pump all the oil a well was capable of producing, thus depleting the well in the shortest possible time and preventing the oil from seeping into an adjoining lease. Even during the initial orders period large-capacity plants were necessary—50-h.p. gas engines driving 40-h.p. pumping units. However, as further orders came into force, making the allowables smaller, smaller units became sufficient, until now only 3- to 4-h.p. units are required. These units are electrical, and the paper gives a description of the general layout and working conditions of the units in the fields showing a material reduction in the operating costs. A. H. N.

1125. **Production Patents.** E. G. Ware. U.S.P. 2,203,759, 11.6.40. Appl. 27.8.38. Pump valve with gas chamber in cage.

F. E. O'Neill. U.S.P. 2,203,796, 11.6.40. Appl. 26.1.39. Method and means of perforating well casing and the like, using laminated members and a jet of abrasive fluid under pressure to form the perforations.

H. C. Glitsch and C. S. Crickmer. U.S.P. 2,203,957, 11.6.40. Appl. 26.4.37. Flow valve adapted to be connected to a tubing string and is pressure-operated.

H. C. Lawton and A. G. Loomis. U.S.P. 2,204,223, 11.6.40. Appl. 30.1.39. Method of treating oil and gas wells for selectively sealing off formations having small quantities of connate waters, these formations being adjacent oil-bearing formations.

D. A. Limerick and H. C. Lawton. U.S.P. 2,204,224, 11.6.40. Appl. 28.2.38. Method for treating oil wells to clean them from high-melting-point organic deposits comprising paraffinic matter by generating heat chemically—*i.e.* by action of inorganic acid and inorganic oxidizing agent on an electropositive metal.

M. de Groote. U.S.P. 2,204,580, 18.6.40. Appl. 17.2.36. Process for increasing the productivity of wells by treating them with acid containing a wetting agent comprising an alkylated sulpho-aromatic acid.

W. J. Crites. U.S.P. 2,204,725, 18.6.40. Appl. 19.10.37. Means for reducing stresses in oil-well pumping equipment consisting of a compressible medium mounted in the pitman.

J. D. Nixon. U.S.P. 2,204,817, 18.6.40. Appl. 26.7.39. Means for flowing wells comprising a fluid inlet valve attached to a tubing string.

C. V. Temple. U.S.P. 2,204,834, 18.6.40. Appl. 8.10.36. Gas-lift valve comprising a main and a pilot valve, both pressure actuated.

A. Hollander. U.S.P. 2,204,857, 18.6.40. Appl. 13.6.38. Series-parallel submersible pump comprising a submersible motor and multistage pump with valves for selectively connecting stages in series or in parallel.

L. A. Layne. U.S.P. 2,205,421, 25.6.40. Appl. 20.10.36. Means and method of treating wells, comprising a pump, pipe, tank, and valve, and working by filling tank from well and keeping valve closed so that pressure in tank increases, then stopping pump and letting liquid from tank surge into well and thus wash it.

L. A. Layne. U.S.P. 2,205,422, 25.6.40. Appl. 23.12.38. Method for forming a gravel pack in a well bore.

R. A. Wilson. U.S.P. 2,205,739, 25.6.40. Appl. 1.10.37. Gas release valve for wells having a flow line with a surrounding packer.

G. S. Knox. U.S.P. 2,205,748, 25.6.40. Appl. 26.6.37. Well-pipe plug.

J. H. McEvoy and J. H. Howard. U.S.P. 2,205,988, 25.6.40. Appl. 16.7.38. Oil-well equipment, being a well-head completion arrangement. A. H. N.

Transport and Storage.

1126. Transport of Hydrocarbons and of Butane and Propane by Tank-Cars. M. Meot. *Science et Ind.*, 1940, 290 bis (Supplement to *Revue Mécanique*), 108–118.—Rail tank-cars for the transport, through France, of liquid petroleum products and of liquefied butane and propane, together with the portable rail containers for the latter gases, are reviewed. The regulations governing the construction and testing of the tank-cars and containers are surveyed in detail, and several photographs and diagrams illustrate the article. Attention is paid to the methods and regulations for mounting the tanks on to the rail chassis. T. C. G. T.

1127. Handling of Hydrocarbons under an Atmosphere of Inert Gas. H. Pinaud. *Science et Ind.*, 1940, 290 bis (Supplement to *Revue Mécanique*), 99–100.—It is suggested that the reduction of explosion risks by handling and storing inflammable liquids in an inert atmosphere should be further developed. Carbon dioxide is an obvious choice for the inert gas, but exhaust gas from a petrol engine offers good possibilities. If the engine is run primarily to produce an inert gas, an exhaust with a composition of 12% carbon dioxide and 84% nitrogen can be obtained, and such a gas is quite inert from a combustion point of view. A general scheme for handling gasoline whereby during the movement of the liquid it is kept entirely under inert gas control is outlined. T. C. G. T.

Crude Petroleum.

1128. Tabulated Analyses of Texas Crude Oils. A. J. Kraemer and G. Wade. U.S.B. of Mines Tech. Paper 607, 1939.—All analyses of Texas crude oils made by the Bureau of Mines to March 1939 have been tabulated in condensed form. C. L. G.

Cracking.

1129. Catalytic Cracking. Anon. *Science et Ind.*, 1940, No. 290 bis (Supplement to *Revue Mécanique*), 32–35.—A general review of the Houdry catalytic cracking process operated by the Magnolia Petroleum Co. The process is illustrated diagrammatically. Tests of the charging stock and of the gasoline yield are shown and the lead susceptibility of the latter also receives attention. The catalysts are naturally occurring materials such as aluminates and silicates, or oxides of certain metals, such as chromium, tungsten, vanadium, etc. The latter type are, of course, more costly and, though much more effective initially, are more easily poisoned. T. C. G. T.

1130.* Inspection of Cracking Plants. B. F. T. Bruera. *Bol. Inform. Petroleras*, Feb. 1940, XVII (186), 35–43.—This is a well-illustrated article dealing with corrosion, erosion, super-heating, vibration, and other causes producing failures in cracking plants, and considered from the point of view of the inspector responsible for maintaining them in good condition. The author, in his introduction, states that, in spite of a great deal of experimental work, no alloy has yet been found which will give complete satisfaction in resisting the individual or combined action of temperature, pressure, corrosion, and the like. H. I. L.

1131. Patent on Cracking. H. Tropsch. U.S.P. 2,203,850, 11.6.40. Appl. 24.1.38. —Conversion of hydrocarbon oil by contacting it at cracking temperature with a modified felspar produced by removing from felspar at least a part of its alkalinous base and aluminium content. On the residual portion of the felspar a salt of a metal the oxide of which is catalytic is absorbed, and thereafter calcined to convert the salt into the catalytic metal oxide supported on the residual portion of the felspar. H. B. M.

Hydrogenation.

1132. Patent on Hydrogenation. Harold Edwin Potts. E.P. 522,037, 6.6.40. Appl. 3.12.38.—Process for the destructive hydrogenation of carbonaceous materials and dephenolising of waste waters. The waste waters are injected behind the reaction vessel into the high-pressure cycle of a destructive hydrogenation system. The phenolic substances are thus dissolved in the hydrogenation products and extracted from the water.

H. E. Potts. E.P. 522,254, 13.6.40. Appl. 3.12.38.—Process for the working up of residues of the hydrogenation under pressure of distillable carbonaceous materials. The residues are first subjected to centrifuging and the centrifuged residues are then submitted to filtration at a temperature between 200° and 400° C.

V. Komarewsky. U.S.P. 2,203,826, 11.6.40. Appl. 31.12.37.—Dehydrogenation of aliphatic hydrocarbons by subjecting them to dehydrogenating conditions in the presence of a catalyst comprising a major proportion of alumina and a minor proportion of chromium sesquioxide and nickel.

L. Heard. U.S.P. 2,205,141, 18.6.40. Appl. 31.12.37.—Dehydrogenation of hydrocarbons by contacting them in the vapour phase at a temperature of 650–1050° F. with a metal chromite catalyst. The catalyst is prepared by the thermal decomposition of a crystalline metal ammonium chromate hexahydrate wherein the metallic constituent is one or more metals selected from the group consisting of magnesium, calcium, cobalt, and nickel. H. B. M.

Polymerization.

1133. Patent on Polymerization. Robert Freeborn Ruthruff. E.P. 521,891, 4.6.40. Appl. 11.10.38.—Modification in method of polymerizing olefinic hydrocarbons or mixtures of same. The hydrocarbons are contacted at a high temperature with a solid catalytic agent comprising essentially copper pyrophosphate.

S. C. Fulton and T. Cross. U.S.P. 2,204,673, 18.6.40. Appl. 19.12.35.—Polymerization of normally gaseous hydrocarbons containing olefins by contacting them at a temperature between 200° and 300° C. with a catalyst prepared by impregnating activated silica gel with aluminium chloride dissolved in ethylene dichloride and heating the mass at a temperature sufficient to drive off the ethylene dichloride. H. B. M.

Synthetic Products.

1134.* Industrial Synthesis of Hydrocarbons from Hydrogen and Carbon Monoxide. A. J. V. Underwood. *Industr. Engng Chem.*, 1940, **32**, 449.—This paper gives an up-to-date summary of the Fischer–Tropsch synthesis of hydrocarbons from hydrogen and carbon monoxide, which may be represented by the following reactions :—

$$n\mathrm{CO} + 2n\mathrm{H_2} \xrightarrow{\text{catalyst}} \mathrm{C}_n\mathrm{H}_{2n} + n\mathrm{H_2O}.$$
$$n\mathrm{CO} + (2n+1)\mathrm{H_2} \xrightarrow{\text{catalyst}} \mathrm{C}_n\mathrm{H}_{2n+2} + n\mathrm{H_2O}.$$

The most efficient catalysts for the synthesis are cobalt, nickel, and iron. It is presumed that the metal reacts with the carbon monoxide and hydrogen, forming metallic carbides, which are subsequently reduced by hydrogen with the formation of methylene radicles; these radicles then polymerize to higher hydrocarbons. Various promoters have been used with the catalysts—namely thoria, magnesia, manganese oxide, and alumina—whilst the most satisfactory support is kieselguhr. In the latest industrial units a supported cobalt catalyst is employed because this metal gives the greatest yield of hydrocarbons and has the longest life. The theoretical yield of hydrocarbons from 1 cubic metre of ideal gas (2 parts H_2 plus 1 part CO) is 208 gm.; yields of 130–140 gm. have been realized in one-stage commercial operation. The synthesis is

carried out at temperatures in the range 190–200° C. and at pressures of from 5 to 10 atmospheres. Increase of pressure has a marked effect on the yield and character of the product, increase of pressure bringing about an increase in yield until a point is reached when further increase in pressure decreases the yield. For operating pressures in excess of 5 atmospheres there is a decrease in the formation of hydrocarbons boiling in the gasoline range, and an increase in the formation of wax. Pressure operation increases catalyst life, and the total yield of hydrocarbons decreases less rapidly than under atmospheric pressure conditions. The activity of the catalyst decreases to some extent by the deposition of wax on its surface, although a high activity can be maintained by periodic removal of the wax, which may be accomplished by treating the catalyst with a suitable solvent or with hydrogen. Accumulated data support the theory that contact time is not a controlling factor in the process, but is rather the rate at which the reaction products can be removed from the neighbourhood of the catalyst.

The industrial process as used by the Ruhrchemie A.-G. is described in outline.

H. E. T.

Refining and Refinery Plant.

1135. Review of the Literature on the Construction, Testing and Operation of Laboratory Fractionating Columns. C. C. Ward. U.S.B. of Mines Tech. Paper 600, 1939.—The report includes: (1) a general consideration of fractionating unit design and operation, (2) the evaluation of columns with examples of graphical and analytical methods of computing the number of theoretical plates, and vapour liquid equilibria data for some common binary test mixtures, (3) a discussion of details of the construction, operation, and evaluation of various fractionating units, and (4) conclusions as to the principal factors to be considered when designing an efficient fractionating unit.

C. L. G.

1136.* Extraction of Mercaptans with Alkaline Solutions. D. L. Yabroff. *Industr. Engng Chem.*, 1940, **32**, 257.—The factors affecting the distribution of a mercaptan between an oil phase and an aqueous alkaline solution are discussed. Data are presented illustrating the distribution of the mercaptans up to heptyl mercaptan between *iso*-octane and aqueous phases of varying sodium hydroxide concentration at 20° C. With increasing molecular weight the solubility of the mercaptans in water falls rapidly. The differences in the extractability of various mercaptans from an oil phase by an aqueous alkaline solution are due almost entirely to differences in the solubility of the unneutralized mercaptan in the aqueous phase.

With increasing sodium hydroxide concentration the improvement in the extraction is less than might be expected from the higher caustic concentration due to the salting out of the unneutralized mercaptan from the aqueous phase. The effect of temperature over the range 0–50° C. on the hydrolysis and partition of *n*-butyl mercaptan between *iso*-octane and aqueous phases has been examined. The extraction of the mercaptan increases as the temperature is lowered, because of the decreased hydrolysis of the mercaptide in the aqueous phase.

Equations, illustrated by an example, are given enabling the extent of the extraction, of mixed mercaptans in a gasoline by an aqueous alkaline solution, to be calculated under once through counter-current conditions.

J. W. H.

1137.* Mixtures of Ketones Used to Dewax Motor Lubricants. A. J. Mueller. *Oil Gas J.*, 18.4.40, **38** (49), 54.—Commercial operation of a 2000-bbl.-per-day solvent dewaxing plant at a Sarnia (Canada) refinery has confirmed the superior qualities of a mixture of methyl *n*-butyl ketone and methyl *n*-propyl ketone. The latter material has the advantage over the former in lower solubility for wax, higher filtering rate, and lower cost, and gives an oil of pour point below the dewaxing temperature, but has a higher miscibility temperature with oil, a lower vapour pressure, and a higher solubility in water. These disadvantages are reduced by blending with methyl *n*-butyl ketone, by providing adequate condensing equipment, and by deketonizing waste water.

Production data on dewaxing Mid Continent and Louden (Illinois) distillate indicate a filter rate of 6 gals. dewaxed oil per sq. ft. per hr. with solvent to oil ratios of less than 2 to 1. Pour points on some stocks are 16° F. below filtration temperature. The wax cake (yield about 10%) is washed to an oil content of 6–8%, simplifying subsequent sweating and increasing the yield of wax. Average solvent loss is 0·1%; separating the cycle-wash solvent from the oil-solvent filtrate and employing it for diluting the incoming charge reduces the quantity of solvent to be recovered and prevents contamination of the filtrate with wax dissolved in the wash solvent. The diluted charge is cooled by controlled chilling from 90° to 30° F. and then shock cooled. No filter aid or precoat is necessary in the filters. No toxic or inflammability effects have been encountered. C. L. G.

1138.* Cathodic Protection of Condensers and Coolers Utilizing Brackish Bay Water. W. A. S. Wright and J. H. Brooks. *Oil Gas J.*, 30.5.40, **39** (3), 60.—Rapid failure of red brass condenser tubes used with brackish bay water for condensing exhaust steam in a San Pablo Bay (Calif.) refinery has led to the following measures: Replacement by Admiralty metal tubes, installation of cathodic protection equipment, use of strainers in salt-water line and a more rigid inspection and cleaning programme.

As a result there has been no tube failure after 14 months' service, only slight corrosion and some scale deposition. Owing to the combination of changes it is not possible to consider the relative effect of the cathodic protection alone. This consisted of cast-iron anodes, 2·5 in. thick, installed in each of the four doors of the condenser, using an electrical current of 7 amps. at 4½ volts, corresponding to 2½ amps. per 1000 sq. ft. of surface. The electrodes are decomposed at the rate of 35 lb. per amp. year, installation being arranged to facilitate replacement. The mild pitting which has been experienced may be due to spacing the anodes too close to the tube sheet, with the resulting turbulence liberating air dissolved in the circulating salt water. The scale deposition has an insulating effect, and results in the current being carried further into the tubes.

Further cathodic protection units have been installed on fresh water-coolers, no tube failures having been reported after 16 months. C. L. G.

1139.* Corrosion in Refineries. C. Lucero. *Bol. Inform. Petroleras*, Feb. 1940, XVII (186), 30–34.—This article deals with the various acids which result in corrosion of the tubes and other parts of the distilling plant. Of these hydrochloric acid and sulphur compounds are responsible for the bulk of the damage, the latter compounds being the most active agents at high temperatures. Methods of combating the corrosion by the use of soda and ammonia are described. H. I. L.

1140.* Prevention of Accidents in Refineries. R. Galletti. *Bol. Inform. Petroleras*, Feb. 1940, XVII (186), 44–52.—This article deals very fully with conditions in refinery plants with respect to accidents and sickness caused directly by the conditions under which the men have to work and by the materials which have to be used in the processes connected with the petroleum industry. H. I. L.

1141. Petroleum Refineries, including Cracking Plants in the United States. G. R. Hopkins and E. W. Cochrane. U.S. Bur. Mines. Information Circular No. 7124, Jan. 1940.—On 1st January, 1940, there were nine more completed refineries in the United States than on 1st January, 1939. This is the first time for four years that the Bureau of Mines has been in a position to record an increase in the number. Actually the total completed on 1st January, 1940, was 547, but eighty-six of these were shut down and some of the rest operating only in part. Nevertheless the figure for operating plants was the highest ever recorded, and seven greater than the previous record established in January 1940.

Practically all the gains in operating plants during 1939 occurred in the Central States, where there were significant oil discoveries.

On 1st January, 1940, the operating capacity of crude petroleum plants was recorded as 4,196,694 brls. and reflected a substantial increase over the 1939 figure. In the same way the idle capacity fell from 574,770 brls. to 431,952 brls. during this period.

New construction continued to decline as far as crude oil capacity was concerned,

and, in addition, the nature of new construction changed in 1939, most of it being additional, whereas in 1938 the greater part was constructed for replacements.

On 1st January, 1940, capacity of active cracking units was recorded as 964,555 brls. per day, and was 10% greater than the figure for the previous year. Idle cracking capacity declined in 1939, but, unlike crude oil, the capacity of cracking units under construction was somewhat higher than the year before. Daily output of cracked gasoline in 1939 was 809,000 brls.—*i.e.*, 88% for active units or 79% for both active and inactive plants. H. B. M.

1142. Manufacture and Use of Petroleum Products. A. J. Kraemer and H. M. Thorne. U.S. Bur. Mines Reprint, 1940.—In 1934 these authors presented a report to a subcommittee of the Committee of Interstate and Foreign Commerce on the effect of technologic factors on the supply of and demand for petroleum products. The present report represents an endeavour to bring the earlier discussion up to date and to direct attention to changes in sources and character of raw materials and products.

It is divided into five sections. Section 1 concerns production of crude petroleum in the United States and gives data relating to sources and stocks of raw materials of the refining industry. The oils vary from very volatile to those which are practically solid at 75° F., and no two crudes are exactly alike. For convenience, however, they are classified into groups according to production areas.

Section 2 includes data regarding the number of refineries in the United States and their distribution among the ten refinery districts.

Information is given on the number of refineries in operation, the number shut down, and total refining capacity for each district; also similar data on cracking plants. In addition, lists are given of quantities of raw materials used and what was made from them, thus indicating the influence of supply and demand on refinery practice in the different districts.

The third section of the report is devoted to petroleum refining technology. Processes of hydrogenation, cyclization, aromatization, and isomerization are briefly described, and emphasis is laid on the value of new refining methods which utilize inferior or waste products to produce superior fuels.

Section 4 comprises a review of certain technologic factors which affect the supply of and demand for the principal petroleum products. Possibilities of increasing supplies of products should the necessity arise and significance of changes in demand for specific products are also discussed. Throughout the section it is borne in mind that almost all petroleum products are used by burning them and that individuals rather than industries are the principal consumers.

The final section of the report deals with the possibilities of alternative fuels being obtained from coal, oil shale, and alcohol. It is pointed out that in each case a greater expenditure in labour and materials is involved than in the manufacture of motor fuels from petroleum. H. B. M.

1143.* Dehydration and Desalation of Oil at Plaza Huincul. H. M. Gonzalez. *Bol. Inform. Petroleras*, Jan. 1940, XVII (185), 24–28.—This article describes experimental treatment of oil at Plaza Huincul for removal of water and salt. The plant is described and a table of results given. These are fairly satisfactory, and the saving on transport is shown as $16,770. H. I. L.

1144.* Problem of Dehydration and Desalation of the Petroleums in Comodoro Rivadavia. C. A. Delorme. *Bol. Inform. Petroleras*, Jan. 1940, XVII (185), 11–23.—This article develops primarily theoretical and experimental data on the question of emulsions, and deals further with the petroleum emulsions of the Comodoro Rivadavia zone, their dehydration on commercial lines, existing dehydration plant, their mode of operation, the effect of other problems and of future requirements. Some interesting photomicrographs are included with the illustrations. H. I. L.

1145. Patents on Refining. W. A. Schulze. U.S.P. 2,204,234, 11.6.40. Appl. 9.11.38. Process for sweetening and stabilizing petroleum oils by admixing air with them, percolating the admixture through a solid absorbent material consisting of fuller's earth impregnated with a solution of a soluble copper salt and a soluble chloride

salt. Thereafter the mixture of oil and unreacted air is contacted with a solid absorbent material consisting of fuller's earth impregnated with an aqueous solution of a non-oxidizing acid compound insoluble in the oil.

A. W. Hixon. U.S.P. 2,204,758, 18.6.40. Appl. 17.12.36. Refining of paraffinic and non-paraffinic petroleum oils by contacting with furonitrile at temperatures above the miscibility temperature, cooling the mass to stratify it into an oil phase and a solvent phase. Thereafter the solvent phase is separated out and treated with triamylamine under conditions designed preferentially to extract certain of the oil constituents from the furonitrile phase.

D. S. McKittrick. U.S.P. 2,204,903, 18.6.40. Appl. 20.7.38. Desulphurizing low-boiling mineral oil by contacting it in the liquid state at about 40° C. with a refining agent comprised essentially of an aliphatic sulphonic acid containing not more than 5 carbon atoms and being liquid at 40° C. The process is carried out under conditions which cause the formation of a sulphonic-acid phase containing absorbed sulphur compounds and a liquid-oil phase. The two phases are finally separated.

R. D. Howard. U.S.P. 2,205,410, 25.6.40. Appl. 25.3.36. Refining of crude mineral oil distillates which are relatively low boiling and contaminated with mercaptan sulphur compounds. The hot vapours of the distillate are mixed with a small portion of a chlorinating agent prediluted with an oxygen-containing gas compatible therewith. The resultant mixture is contacted with a dechlorinating material containing zinc in oxidized form to dechlorinate and sweeten the vapours and a refined relatively low-boiling mineral oil distillate is condensed from the residual vapours.

Edelenau Gesellschaft m.b.H. E.P. 521,658, 28.5.40. Appl. 24.11.38. Extraction of mineral oils, mineral oil fractions, or residual oils with selective solvents. The oil to be treated and the solvent are led in counter current to each other, and the oil is cooled before entering the extraction apparatus. A portion of the extract solution is withdrawn from the extraction apparatus and mixed with the oil before it enters the cooling apparatus affixed to the front of the extraction apparatus. H. B. M.

Chemistry and Physics of Petroleum.

1146. Isolation of 3-Methylhexane, *trans*-1 : 2-Dimethyl*cyclo*pentane and *trans*-1 : 3-Dimethyl*cyclo*pentane from Petroleum. A. R. Glasgow, Jr. *Bur. Stand. J. Res.* (*Wash.*), 1940, **24** (5), 509–529.—The fraction of a mid-continent petroleum, b.pt. 90–92° C., previously freed from aromatic hydrocarbons, was used for this work.

Systematic distillation of this material showed that naphthenic compounds were concentrating below 90° C., paraffins in the region 90–91·2° C., and the volume of distillate fell to a minimum at 91·2° C. with increasing naphthenic content.

The portion b.pt. 90–91·2° C. was processed by azeotropic distillation with methyl alcohol, which resolved it into paraffinous and naphthenic concentrates.

From the naphthenic concentrate *trans*-1 : 3-dimethyl*cyclo*pentane was isolated by crystallization from liquid ethane.

The fraction b.pt. 91·2–92·2° C. was then distilled with methyl alcohol alternating with ordinary distillation, and *trans*-1 : 2-dimethyl*cyclo*pentane was isolated by crystallization from liquid propane plus methane. From the paraffinic concentrate 3-methylhexane was obtained in the residue from distillations at 315 mm. Hg.

The b.pt., refractive index, f.pt., density, C/H ratio, and aniline point were determined for the three hydrocarbons. Regarding the content of *n*-heptane as 1, the relative amounts of the three hydrocarbons in this petroleum were estimated to be: *trans*-1 : 3-dimethyl*cyclo*pentane 0·21; 3-methylhexane 0·25; *trans*-1 : 2-dimethyl*cyclo*pentane 0·31. D. L. S.

1147. Vapour–Liquid Equilibrium. V. Carbon Tetrachloride–Benzene Mixtures. G. Scatchard, S. E. Wood, and J. M. Mochel. *J. Amer. chem. Soc.*, 1940, **62**, 712–716.—This work completes the measurements on binary systems of the compounds carbon tetrachloride, *cyclo*hexane, and benzene. As before (*J. Amer. chem. Soc.*, 1939, **61**, 3206–3210; *J. Inst. Petrol.*, 1940, **26**, Abstr. No. 651) the vapour–liquid

equilibrium pressure and composition were measured at 40° and 70° C. throughout the composition range of carbon tetrachloride and benzene mixtures, and at 30°, 50°, and 60° C. for approximately equimolar mixtures. The densities were measured at 25° C. Analysis of these results shows slight deviations from corresponding equations derived from thermodynamic functions, including the energy and entropy of mixing at constant total volume. Approximate equations are derived for the ternary system benzene–*cyclo*hexane–carbon tetrachloride. R. D. S.

1148. Attempt to Synthesize a Substituted *cyclo*-Octatetraene. S. Wawzonek. *J. Amer. chem. Soc.*, 1940, **62**, 745–749.—An attempt was made to synthesize *sym.*-dibenzo*cyclo*octatetraene from diphensuccindene-10 through *sym.*-dibenzo*cyclo*octanedione-5, 11, but as the synthesis could not be completed, the properties of the cyclic diketone were examined and found to be similar to those of open-chained 1 : 5-diketones. R. D. S.

1149. Separation of the Isomeric Hexenes by Batch Fractionation. A. Rose. *J. Amer. chem. Soc.*, 1940, **62**, 793–795.—This paper applies an extension of the reasoning of Sidney Young and of Rayleigh to the separation of the isomeric hexenes in an attempt to arrive at the required fractionating efficiency and some idea of the results to be expected. The computations show that even with practically total reflux and zero hold-up at least 400 theoretical plates are required to ensure sharp separation of some of the close-boiling hexenes. R. D. S.

1150. Attempted Separation of the Isomeric Hexenes by Fractional Distillation. F. C. Whitmore, and others. *J. Amer. chem. Soc.*, 1940, **62**, 795–800.—The authors were unable to substantiate work on this subject by Goldwasser and Taylor (*J. Amer. chem. Soc.*, 1939, **61**, 1751), who employed a Podbielniak–Simons–Taylor column, for whereas the investigations of Goldwasser and Taylor indicated separation of six hexenes with a total b.pt. range of 2·5° C., the present authors could not obtain separations even with two binary mixtures of purer hexenes of boiling ranges of 1·5° C. and 2·7° C., or with a ternary mixture having a b.pt. spread of 2·7° C.; furthermore, whilst the Podbielniak–Simons–Taylor column has an efficiency of only about fifteen theoretical plates, the calculations in the previous paper show that an efficiency of more than 400 theoretical plates is necessary to effect separations of the six hexenes. R. D. S.

1151. Vapour Pressures of Certain Unsaturated Hydrocarbons. A. B. Lamb and E. E. Roper. *J. Amer. chem. Soc.*, 1940, **62**, 805–814.—Using a double-vapour-pressure apparatus permitting the simultaneous measurement of the vapour pressures of two samples at a given temperature-setting of a surrounding cryostat, the authors have measured the vapour pressures of liquid ethene, propene, 2-methylpropene, 1-butene, *cis*-2-butene, *trans*-2-butene, 1 : 4-pentadiene and 2-methyl-2-butene over the approximate range 10–1000 mm., and have derived by the method of least squares from these results equations containing three constants expressing vapour pressure as a function of temperature; they have also obtained constants for an empirical equation for propadiene in the crystalline phase by drawing the best line through the data and constants for the equation for liquid propadiene by the least-squares method. From the empirical equations for the vapour pressure the authors have computed the boiling points and temperature coefficients of the vapour pressures, and from these, in turn, obtained the molecular heats of vaporization. Generally, the vapour pressures quoted show satisfactory agreement with the Ramsay–Young rule and the Dühring rule, especially where in each rule an additional constant is introduced. A general equation has been derived which expresses the temperature differential of the vapour pressure at the absolute boiling point as a function of the absolute boiling point. R. D. S.

1152. Halogenation of Unsymmetrical Diphenylethane. F. E. Sheibley and C. F. Prutton. *J. Amer. chem. Soc.*, 1940, **62**, 840–841.—When the product of the photochemical chlorination of 1 : 1-diphenylethane is distilled the distillate consists of unchanged diphenylethane, stilbene, and 1 : 1-diphenyl-2 : 2-dichloroethylene. Bromination mixtures, similarly prepared and distilled, give only small amounts of

1 : 1 : 4 : 4-tetraphenylbutadiene-1 : 3 and stilbene. Owing to its remarkable stability, 1 : 1-diphenyl-2 : 2-dichloroethylene requires the action of alcoholic caustic potash under pressure at 150° C. to effect complete hydrolysis. The pyrolysis of 1 : 1-diphenylethane in a silica tube at 700° C. gives benzene, toluene, and styrene in small amounts. R. D. S.

1153. Condensation of Esters with Aromatic Hydrocarbons by Means of Aluminium Chloride. J. F. Norris and P. Arthur, Jr. *J. Amer. chem. Soc.*, 1940, **62**, 874–877.—This paper presents results of investigations into the condensations of methyl and ethyl formate and acetate with benzene and toluene by means of aluminium chloride, with reference to the conditions necessary to produce alkylation alone or simultaneous alkylation and acylation. It was found that alkylation and acylation required a higher temperature than alkylation alone for ethyl acetate; acylation of methyl and ethyl formates could not be effected. The pyrolitic product of methyl acetate and aluminium chloride produced methyl chloride, and the residue obtained in a like manner from ethyl acetate and aluminium chloride formed acetophenone in 42% yield when it was condensed with benzene. Identification of the ketones formed from methyl acetate was performed by use of some new 4-nitro- and 2 : 4-dinitro-phenylhydrazones of 2 : 4- and 2 : 5-, and 3 : 4-dimethylacetophenones prepared by the authors. R. D. S.

1154. 9-Methyl-3 : 4-Benzfluorene. L. F. Fieser and Ll. M. Joshel. *J. Amer. chem. Soc.*, 1940, **62**, 957–958.—This compound was synthesized because of the somewhat analogous hydrocarbon 10-methyl-1 : 2-benzanthracene being of marked carcinogenic activity. 3 : 4-Benzfluorenone-9 was prepared from 1-phenyl-2 : 3-naphthalic anhydride and the ketone was then condensed with methyl magnesium chloride to a carbinol which gave the desired hydrocarbon on heating in acetic acid and shaking with hydrogen and Adams catalyst. R. D. S.

1155. Synthesis of 2-Methyl-3 : 4-Benzphenanthrene. M. S. Newman and Ll. M. Joshel. *J. Amer. chem. Soc.*, 1940, **62**, 972–974.—Direct cyclization of *p*-benzohydrylglutaric acid using anhydrous hydrogen fluoride, or ring closure of the anhydride using aluminium chloride, gave 1 : 2 : 3 : 4-tetrahydro-4-keto-1-phenyl-2-naphthaleneacetic acid. The reduction of the keto-group gave the hexahydro-ketone, which, under the influence of the appropriate Grignard reagent, followed by dehydration and dehydrogenation, gave 2-methyl-3 : 4- and 2-ethyl-3 : 4-benzphenanthrene. The former of these hydrocarbons is very carcinogenically potent when painted on the skin, but not so active when applied by the injection technique. R. D. S.

1156. Low Temperature Dehydrogenations. II. R. T. Arnold, C. Collins, and W. Zenk. *J. Amer. chem. Soc.*, 1940, **62**, 983–984.—A note on the preparation of unsymmetrical biphenyl, terphenyls, etc., in 50–70% yields by dehydrogenation of substituted *cyclo*hexenes under reflux with chloranil or other quinones with high oxidation potentials. R. D. S.

1157. Viscosities of Linear Poly-esters. An Exact Relationship Between Viscosity and Chain Length. P. J. Flory. *J. Amer. chem. Soc.*, 1940, **62**, 1057–1070.—The author has measured the viscosities, densities, and thermal expansion coefficients of linear poly-esters having molecular weights ranging from 200 to over 10,000, and finds that the logarithm of the viscosity is an exact linear function of the square root of the weight average chain length or of the square root of the weight average molecular weight according to the equations: $\log \eta = A + C'M_w^{\frac{1}{2}} = A + CZ_w^{\frac{1}{2}}$, where M_w is the weight average molecular weight, Z_w the weight average chain length, and A, C, and C' are constants.

The relationship between viscosity and weight average chain length applies to mixtures of two poly-esters of low and high average molecular weights, respectively; hence the author deduces that it is independent of the type of distribution of species in the polymer. The molecular weight has only a slight influence on the viscosity–temperature coefficient, so that the relationship between viscosity and weight average

chain length, as well as the constant C in the equation, must likewise be independent of temperature. The author concludes that the elementary process of viscous flow must consist either of a displacement of a small portion of the entire molecule or of a displacement of the entire molecule through a comparatively small distance; furthermore, such a displacement cannot be commensurate with the size of the molecules, and the activation energy for viscous flow must be unconnected with molecular size. The equation can be further usefully employed to determine directly the weight average molecular weight from viscosities of the poly-esters. R. D. S.

1158. Petroleum Bases. I. Reactions of 2 : 3 : 8-Trimethylquinoline. A. Burger and L. R. Modlin. *J. Amer. chem. Soc.*, 1940, **62**, 1079–1083.—A study of the reactivity of the 2 and 5 positions of the quinoline system of this kerosine base. R. D. S.

1159. Redistribution Reaction. V. R,Pb Compounds. G. Calingaert, H. A. Beatty, and H. Soroos. *J. Amer. chem. Soc.*, 1940, **62**, 1099–1104.—The redistribution reaction is perfectly general for these compounds, as data on fourteen systems, both alkyl and aryl, show. The effect of such factors as the R groups, catalysts, catalyst concentration, solvents, temperature, and time are given. R. D. S.

1160. Redistribution Reaction. VI. Alkyl Lead Halides. G. Calingaert, H. Soroos, and H. Shapiro. *J. Amer. chem. Soc.*, 1940, **62**, 1104–1107.—From the data presented in this paper the authors confirm that when trialkyl-lead halides undergo the redistribution reaction they require no other catalyst than themselves. Six systems were investigated, comprising a mixed trialkyl-lead halide, four trialkyl-lead halide–tetraalkyl-lead systems, and one system of two different trialkyl-lead halides, the alkyl groups being methyl and ethyl. For systems involving only trialkyl-lead halides the theory predicts a random equilibrium mixture of all four possible trialkyl-lead halides; for systems involving tetraalkyl-lead, the theory predicts five lead alkyls and four trialkyl-lead halides. These random equilibria were confirmed by analysis after completion of reaction. R. D. S.

1161. Redistribution Reaction. VII. Alkyl Compounds of Mercury, Tin, Silicon, and Zinc. G. Calingaert, H. Soroos, and V. Hrizda. *J. Amer. chem. Soc.*, 1940, **62**, 1107–1110.—The results of these experiments demonstrated that mercury, tin, and silicon alkyls undergo the redistribution reaction in the same way as these compounds of lead. Similar zinc compounds, however, did not react, even with catalysts, such as aluminium chloride at the boiling temperature (60° C.); different conditions and higher temperatures have not yet been applied. Contrary to previous reports in the literature, methylethylmercury was found to be stable on distillation or on standing, when free from catalytic amounts of alkylmercuric chloride which causes redistribution. R. D. S.

1162. Thermodynamics of *n*-Heptane and 2 : 2 : 4-Trimethylpentane, including Heat Capacities, Heats of Fusion, and Vaporization and Entropies. K. S. Pitzer. *J. Amer. chem. Soc.*, 1940, **62**, 1224–1227.—The thermal characteristics were investigated between 15° and 423° K., and tables in the paper give the heat capacities in the solid, liquid, or gas phase. The other properties are :—

	n-Heptane.	2 : 2 : 4-Trimethylpentane.
Heat of fusion, cal. per mole.	3355·8 ± 4	2201·6 ± 2
Heat of vaporization " "	7660 ± 20	7410 ± 20
Entropy (liq., 298·1° K.) . .	78·60 ± 0·2	78·40 ± 0·2
Entropy (gas, b.pt.) . . .	111·77 ± 0·3	112·05 ± 0·3

R. D. S.

1163.* Temperature of Flame Gases. W. T. David. *Engineering*, 1940, **149**, 241.—The calculated and experimentally determined flame temperatures for propane and ethylene are compared over a range of mixture strengths. The experimental determinations were those by the sodium-line reversal method. The various possible reasons for the discrepancies between the two sets of values are reviewed, and it is

suggested that a possible reason is that the gas mixtures were not of uniform composition. The conclusion is reached that sodium-line reversal determinations are untrustworthy, and that some form of wire method (resistance or thermocouple) is preferable. P. D.

1164.* Calculation of Chemical Equilibrium at High Pressures. R. H. Ewell. *Industr. Engng Chem.*, 1940, **32**, 2, 147.—The methods of calculating equilibrium from available thermal data are discussed and their application is illustrated by calculations of the methanol synthesis, the hydration of olefins, and the production of hydrogen cyanide from nitrogen and acetylene. P. D.

1165.* Detergents from Kerosine. A. R. Padgett and E. F. Degering. *Industr. Engng Chem.*, 1940, **32**, 204.—A kerosine fraction boiling at 95–100° C. (15 mm.) was chlorinated to give a yield of 80–90% of monochlorides. Conversion of the monochlorides into the corresponding alcohols was accomplished by a procedure essentially that employed by the Sharples Solvents Corporation, the yield being about 30%. The alcohols were then converted into the corresponding sodium alkyl sulphates.

The 2-, 3-, 4-, 5-, and 6-dodecanols were prepared and the corresponding alkyl sulphates were obtained from them; sodium lauryl sulphate was also prepared from 1-dodecanol.

The various sodium alkyl sulphates were compared by means of foam tests and an interfacial tension test. These tests indicated that the ability to lower interfacial tension and the foam value for a given chain decrease progressively from a maximum for a primary to a minimum for a symmetrical secondary sodium alkyl sulphate.

The sodium alkyl sulphates prepared from the kerosine fraction are inferior to similar compounds with a terminal polar group when assessed by the foam and interfacial tension tests. H. E. T.

1166.* Evaporative Index. G. S. Gardner. *Industr. Engng Chem.*, 1940, **32**, 226.—The mathematical derivation of a simplified Maxwell–Stefan equation is given for the rate of evaporation (E) at a definite point on a liquid surface under constant temperature, pressure, and air flow conditions as

$$E = K(D_1 M p_{A1})$$

in which the group ($D_1 M p_{A1}$) termed the evaporative index may be calculated from a knowledge of the diffusion coefficient (D_1), the molecular weight (M), and the vapour pressure of the evaporating liquid (p_{A1}). For the purpose of the above equation it is sufficient to calculate the diffusion coefficient from the molecular volume by means of the Gilliland equation. The practical utility of the evaporative index is demonstrated by a comparison between calculated and determined values of the rate of evaporation, under carefully controlled conditions, for a large number of different liquids.

The term K in the above equation equals $\frac{a}{RTPx}$, where a is a proportionality constant and x the thickness of the stagnant film above the surface of the liquid. By assuming that x varies as a function of the Reynolds group, it is possible to extend the simplified equation to apply to varying conditions of temperature and pressure. J. W. H.

1167.* Catalytic Dehydrogenation of Gaseous Paraffins. A. V. Grosse and V. N. Ipatieff. *Industr. Engng Chem.*, 1940, **32**, 268.—A catalytic dehydrogenation process has been developed for converting normal and *iso*butane, propane and ethane into the corresponding olefins. The process consists essentially in passing the preheated paraffin gases over a suitable catalyst. The outgoing gases contain olefins and hydrogen besides unreacted paraffin. The olefins are polymerized or used in alkylation reactions, the hydrogen is separated and the residual paraffins are recycled. A suitable catalyst for an economic process must satisfy the following conditions:—

(1) It must have the ability to selectively split off hydrogen without cleavage of C–C bonds.
(2) It must be easily regenerated when fouled by carbon.
(3) It must have a comparatively long life.
(4) It must be low-priced.

The above requirements are fulfilled by selected solid catalysts containing small quantities of the oxides of the transition metals of groups VI (chromium and molybdenum), V (vanadium), and IV (titanium and cerium) of the periodic system, supported on carriers of relatively low activity (*e.g.*, aluminium and magnesium).

Under proper dehydrogenating conditions over-all conversions of the paraffin into olefins of 90–95% of theoretical were obtained, and at the same time an equal volume of almost pure hydrogen (over 90%) suitable for catalytic hydrogenations was produced as a side-product.

The olefins produced were identified by molecular weight, boiling point, refractive index, and formation of the bromides.

The dependence of conversion of paraffins into olefins on space velocity, temperature, and age of catalyst is discussed. H. E. T.

1168.* Benzene and Toluene Isopiestic Liquid–Vapour Equilibrium Data. F. Todd. *Industr. Engng Chem.*, 1940, **32**, 2, 287.—The data on the benzene–toluene system in the literature is critically examined and a table giving the equilibrium compositions on boiling points at 760 mm. P. D.

1169.* Free Discharge of Fluids through Small Circular Orifices. H. L. Roy and N. K. Sen-Gupta. *Industr. Engng Chem.*, 1940, **32**, 2, 288.—Experiments were made on the free discharge from a large tank through orifices ranging from $\frac{1}{8}$ to $\frac{3}{8}$ in. in diameter, using water and oils with viscosities up to 700 centipoises. The Reynolds number was varied from 1 to 10^5. The results are presented in tabular and graphical form. P. D.

1170.* Catalytic Alkylation of *iso*Butane with Gaseous Olefins. F. H. Blunck and D. R. Carmody. *Industr. Engng Chem.*, 1940, **32**, 328.—Alkylation of *iso*butane at 1000 lb. per square inch pressure and at a temperature of 400° F. has been effected with the following olefins, ethylene, propylene, and *iso*butylene, under the catalytic influence of the double chlorides of aluminium and alkalic metals. The double compounds of alkalic halides and aluminium halides used as catalysts were supported on pumice, which was shown to have no catalytic action. The alkylation reaction is accompanied by a varying but considerable amount of polymerization and by extensive rearrangements, leading to the production of side products which are difficult to explain by any simple theoretical consideration. Catalyst life is of short duration, and the rate of decay of the alkylation reaction is greater than that for polymerization. High temperatures favour alkylation, but at the same time produce a decrease in catalyst life. H. E. T.

1171.* Liquid–Vapour Equilibrium Relations in Binary Systems. W. B. Kay. *Industr. Engng Chem.*, 1940, **32**, 3, 353.—The P–V–T–x relations were measured for the ethane–*n*-butane system over the entire range up to the critical. The results are given in graphical and tabular form. Equilibrium constants were derived from the results and are compared with those obtained by calculation. The equilibrium constants for ethane in *n*-butane are compared with those for ethane in *n*-heptane. P. D.

1172.* P–V–T Relations for *n*-Butane. W. B. Kay. *Industr. Engng Chem.*, 1940, **32**, 3, 358.—The vapour pressure and density of the saturated liquid and vapour were measured from room temperature up to the critical point. The compressibility of liquid and vapour was measured from 100° F. to 600° F. and 35 to 1200 lb. per sq. in. P. D.

1173.* Specific Heat Ratios for Hydrocarbons. W. C. Edmister. *Industr. Engng Chem.*, 1940, **32**, 3, 373.—The C_p/C_v ratios for seventeen hydrocarbons were plotted on a reduced basis. It was found that the plots could be made to coincide by using a single multiplying factor for each hydrocarbon. Using this as a basis, a chart is presented from which the value of the ratio for any one of the seventeen hydrocarbons can be obtained at reduced pressures up to 1·2 and reduced temperatures up to 2·5. P. D.

1174.* Phase Equilibria in Hydrocarbon Systems. Joule–Thomson Coefficients for Gaseous Mixtures of Methane and *n*-Butane. R. A. Budenholzer, B. H. Sage, and W. N. Lacey. *Industr. Engng Chem.*, 1940, **32**, 3, 384.—Joule–Thomson coefficients were measured for five mixtures at temperatures between 70° and 310° F. and pressures between 50 and 1500 lb. per sq. in. The figures obtained, combined with the isobaric heat capacity at infinite attenuation, are used to calculate the heat capacities of several mixtures as functions of pressure and temperature. The results are presented in graphical and tabular form. P. D.

1175.* Isothermal Changes in Enthalpy for Some Gases. R. York and H. C. Weber. *Industr. Engng Chem.*, 1940, **32**, 3, 388.—Isothermal changes of enthalpy with pressure of ethane, propane, butane, and heptane have been correlated by an empirical method. The correlation is compared with values taken from the literature for carbon dioxide, methane, and benzene. The method does not fit the gases of low-boiling liquids, nor the so-called highly polar compounds, but it is believed to be reliable between $Tr = 1{\cdot}00$ and $Tr = 1{\cdot}80$ and $Pr = 0$ and $Pr = 8$ for hydrocarbons with critical temperatures between 300° and 600° K. P. D.

1176.* Analytical Calculations of Thermodynamic Properties. H. M. Robinson and H. Bliss. *Industr. Engng Chem.*, 1940, **32**, 3, 396.—Equations for calculating entropy and enthalpy in terms of volume have been derived for the Van du Waals, Wohl, and Beattie–Bridgeman equations of state, and have been tested by comparing calculated values of entropy and enthalpy with those determined graphically. The Beattie–Bridgeman equation is satisfactory to 5–7% for entropy and to 12% for enthalpy. P. D.

1177.* Sulphonation and Nitration Reaction Promoted by Boron Fluoride. R. J. Thomas, W. F. Anzilotti, and G. F. Hennion. *Industr. Engng Chem.*, 1940, **32**, 408.—Boron fluoride is an effective promoter and dehydrating agent for many sulphonation and nitration reactions. Experimental details are given of typical processes involving the use of boron fluoride. By the use of boron fluoride it is possible to sulphonate or nitrate with the stoichiometric amounts of sulphuric or nitric acid; the boron fluoride is converted into the monohydrate and, if an excess of water be added, the dihydrate is formed from which the anhydrous boron fluoride may be recovered. J. W. H.

1178.* Nitration of Ethane. H. J. Hibshman, E. H. Pierson, and H. B. Hass. *Industr. Engng Chem.*, 1940, **32**, 427.—The trinitrate of 2-hydroxymethyl-2-nitro-1 : 3-propanediol and the dinitrate of 2-methyl-2-nitro-1 : 3-propanediol are high-explosive derivatives of nitromethane and nitroethane. These products may be produced from air, steam, and natural gas as raw materials. The variables controlling the vapour-phase nitration of ethane have been examined, and data are presented showing the effect of temperature, molecular ratio, contact time, reaction space, and the presence of potassium nitrate on the conversion. Under carefully controlled conditions it is possible to raise the 9% conversion previously reported to 33% based on the nitric acid; the ratio of nitromethane to nitroethane is 27 : 73 by weight. J. W. H.

1179.* Pressure Gradient Fractionation of Gases. J. W. Creely and G. C. Le Compte. *Industr. Engng Chem.*, 1940, **32**, 3, 430.—Assuming Henry's Law, equations are developed to show the distribution of a multi-component gas between a solvent and a gaseous phase. The method of using these to calculate the composition of the gas phase obtained as the pressure on a solution is gradually reduced is illustrated by an example. The equations are then extended to calculate the separation obtained in a counter-current system in which solvent flows counter current to gas, the pressure on the solvent increasing towards the top of the column. A means of accomplishing this practically is indicated. P. D.

1180.* The System Benzene–Nitrogen. Liquid–Vapour Phase Equilibrium at Elevated Pressures. P. Miller and B. F. Dodge. *Industr. Engng Chem.*, 1940, **32**, 3, 434.—

The vapour–liquid equilibrium was determined at pressures up to 300 atm. and at temperatures from 30° to 125° C. The results are given in tabular and graphical form, and the applicability of Henry's Law is discussed. P. D.

1181.* Detergents from Kerosine. A. R. Padgett and E. F. Degering. *Industr. Engng Chem.*, 1940, **32**, 486.—A fraction boiling at 95–100° C. (15 mm.) was prepared from kerosine supplied by the Standard Oil Co. (Indiana). This fraction, which corresponds to the boiling range of dodecane, was chlorinated to yield about 85% of the monochlorides (kerosyl chloride) which were subsequently converted into *NN*-diethanolkerosylamino by digesting with diethanolamine for 18 hr. at 185° C.

Laurylamine, *NN*-diethyl-laurylamine, and *NN*-diethanollaurylamine, and the corresponding chlorides were prepared for use as reference compounds from lauryl bromide.

The amine hydrochlorides were then compared against sodium lauryl sulphate as a standard, by means of a foam test and an interfacial tension test. The results obtained indicated that the amine hydrochlorides which were prepared were less satisfactory as foaming agents than sodium lauryl sulphate, although the primary amine hydrochlorides appear to be more satisfactory than the secondary compounds. The least satisfactory of the compounds examined as foaming agents were the amine hydrochlorides prepared from the kerosine. H. E. T.

1182.* Viscosity of Hydrocarbon Solutions. Methane–Ethane–Crystal Oil System. B. H. Sage and W. N. Lacey. *Industr. Engng Chem.*, 1940, **32**, 4, 587.—The viscosities of a series of mixtures of the three components were measured at 100° F. and at pressures up to 2500 lb. per sq. in. The majority of determinations were in the condensed region, but some figures were obtained for the liquid phase in the 2-phase region. The per cent. by weight of methane was varied from 0 to 4·7 and of ethane from 1 to 10 approximately. P. D.

1183.* Calculation of Boiling Points of Aliphatic Hydrocarbons. C. R. Kinney. *Industr. Engng Chem.*, 1940, 32, 559.—The calculation of the boiling points of paraffins, olefines, acetylenes, and naphthenes from the hydrocarbon structure may be carried out by the use of a cube-root function of the molecular boiling-point number. This number is arrived at by adding together the values of the boiling-point numbers assigned to the various atoms, radicles, and linkages. By this means it is possible to calculate the boiling point of hydrocarbons with an accuracy of 5% in most cases. Alternatively, the boiling point and the molecular formula may be used to assist the determination of the hydrocarbon structure. A list of hydrocarbons, the determined boiling point of which differs by more than 10% from the value calculated from the molecular boiling-point number, is given. From an examination of this data it is apparent that certain of the boiling points or structures assigned to the hydrocarbons in this list are in error. J. W. H.

1184. Pressure and Temperature Effects on the Viscosity of Liquids. D. Frisch, H. Eyring, and J. F. Kincaid. *J. appl. Phys.*, 1940, **11**, 1, 75.—A theory of viscosity is advanced based on the energy of activation of the process of pairs of molecules lying in adjoining layers in the liquid rolling over each other. The theory is applied to *n*-pentane, ether, benzene, *iso*pentane, water, and mercury, and it is shown that the effect of pressure on liquid viscosity can be calculated with reasonable success from thermodynamic data alone. P. D.

1185.* Analyses Present Evidence on Origin of Petroleum. W. V. Howard. *Oil Gas J.*, 11.4.40, **38** (48), 46.—In an investigation of the relationship of stratigraphy to the type of crude oil, a method of classifying crude oils according to their chemical nature has been worked out. By plotting the reciprocals of the boiling points of 25° boiling range fractions as abscissæ against the specific gravity of the fraction as ordinates it was found that the points representing straight-chain paraffins lie on a straight line, and that no other hydrocarbons fall to the left of that line. It is accordingly given a zero index number. A parallel line through the point represented by benzene was

given a value of 100, practically all other hydrocarbons falling between these limits. *Iso*-compounds have ranges from 5 to 20, the naphthenes between 25 and 50, and the aromatics between 50 and 100. The addition of chains such as pentyl groups to the aromatics or naphthenes lowers their indices so that the index gives an idea of the paraffinicity or naphthenicity of the oil. An examination of a variety of crude oils along these lines has been carried out, enabling the common source of oils from different fields to be correlated and variations in oils in adjacent districts to be distinguished. The work should provide much information of theoretical value concerning the origin, evolution, and migration of crude. For example, where there are families of closely associated oils occurring on definite trends, the existence of two oils lying on a line parallel to this trend, and which are similar to one another and different from those in the trend, may point to the existence of a parallel series of pools. Variations in the oil within a pool may lead to the determination of water levels, if it is found that there is a tendency to increasing naphthenicity or paraffinicity resulting from reactions between the oil and edge water. Sharp variations within pools show the presence of impermeable sections preventing migration and intermixing. This in turn will throw light on well spacing, repressuring, or flooding problems. Much further data on oils of definitely known stratigraphic location is required before any conclusions can be reached as to the origin or migration of oils, in particular the effect of metallic constituents and of sulphur will require studying. C. L. G.

1186. Boiling Points of *n*-Heptane and 2 : 2 : 4-Trimethylpentane over the Range 100 to 1500-Millimeter Pressure. E. R. Smith. *Bur. Stand. J. Res.* (*Wash.*), 1940, **24** (3), 229–234.—In the comparative dynamic method of measuring the b.pt. of liquids, successive measurements are made of the b.pt. of the substance under investigation and the b.pt. of water in ebulliometers connected to the same manostat by means of which the pressure can be varied.

Two simple barometric ebulliometers of the Swietoslawski type were sealed to a manostat through drying tubes.

A diagram and full description of the apparatus and method of procedure are included in the paper.

Data have been obtained from which the following equations were developed to express the relationship between temperature and vapour pressure from 100 to 1500 mm.

For *n*-heptane

$$\log_{10} p = 6{\cdot}905113 - \frac{1269{\cdot}821}{217{\cdot}110 + t}.$$

For 2 : 2 : 4-trimethylpentane

$$\log_{10} p = 6{\cdot}820137 - \frac{1262{\cdot}707}{221{\cdot}307 + t}.$$

In these equations p is the vapour pressure in standard mm. of Hg exerted by the substance at the temperature t in ° C. D. L. S.

1186a. Separation of the Aromatic Hydrocarbons and the Isolation of *n*-Dodecane, Naphthalene, 1-Methylnaphthalene and 2-Methylnaphthalene from the Kerosine Fraction of Petroleum. B. J. Mair and A. J. Streiff. *Bur. Stand. J. Res.* (*Wash.*), 1940, **24** (4), 395–414.—The kerosine stock used in this investigation came from an Oklahoma crude already used for the investigation of the gasoline and lubricant fraction.

That part of the petroleum distilling 114–144° C. at a pressure of 56 mm. Hg (corresponding approximately to 200–230° C. at 760 mm. Hg) was separated into a series of substantially constant-boiling fractions. The greater part of the *n*-dodecane was then removed by crystallization from the fractions distilling 127–133° C. The remainder of the distillation fractions and the mother-liquors from the crystallization of the dodecane were separated by extraction with methyl cyanide and Marcol into (1) fractions of aromatic hydrocarbons and (2) raffinate fractions containing paraffins and naphthenes with about 2½% aromatics. The aromatics were removed from (2) by adsorption with silica gel.

The aromatic fractions were then systematically distilled in high-efficiency columns and from the material boiling at 56 mm. Hg between 127–127·5° C., 145–146·5, and

148·5–149° C., respectively, naphthalene, 2-methyl-naphthalene and 1-methylnaphthalene were isolated by fractional crystallisation.

"Best" lots of each of the four hydrocarbons were prepared with impurities estimated to be, in terms of mole fraction: *n*-dodecane 0·0000 ± 0·0006; naphthalene 0·0006 ± 0·0004; 1-methylnaphthalene 0·0025 ± 0·0011; 2-methylnaphthalene 0·0000 ± 0·0003.

The following properties of these hydrocarbons all extrapolated to material of 100% were determined: B.pt. at 760 mm. Hg, f.pt. in air, density, refractive index and refractive dispersion. D. L. S.

Motor Fuels.

1187. Processes in the Production of Aviation Gasoline. C. Biroreau. *Science et Ind.*, 1940, No. 290 bis (Supplement to *Revue Mécanique*, 26–27).—A general brief review of the processes adopted for the production of a high-performance motor fuel. The development of the petroleum industry towards a chemical industry is stressed. T. C. G. T.

1188. High-Octane-Number Motor Spirits by Hydrogenation. Anon. *Sci. et Ind.*, 1940, No. 290 bis (Supplement to *Revue Mécanique*), 28–31.—Hydrogenated spirits are being produced in two main groups: (1) spirits of about 76 octane value by the hydrogenation of coal and crude oil and (2) spirits of about 100 octane value by the hydrogenation of polymers—*e.g.*, di*iso*butylene to *iso*-octane. The established processes for the production of such fuels are reviewed and some plant designs are presented. The tests of typical charging stocks and the yields results from their hydrogenation are tabulated. Some attention is paid to the lead susceptibility of the fuels. Specifications for Army 102 and 104 octane-value aviation fuels are tabulated. A short note on hydrogen production is included. T. C. G. T.

1189. Catalytic Reforming. Anon. *Sci. et Ind.*, 1940, No. 290 bis (Supplement to *Revue Mécanique*), 35–36.—The value of catalytic reforming in raising octane values of gasolines is demonstrated by a table of the properties of ten gasolines before and after reforming. In one case 99% of a 45 octane-value Mid-Continent gasoline was converted into 53 octane value, whilst in another case 93% of a South Texas gasoline with an octane value of 29 (boiling range 44–209° C.) was converted into 50½ octane value. The catalysts are often natural earths, and 1-tonne will treat 5000 brls.—that is, assuming ten regenerations of the catalyst before it is finally rejected. T. C. G. T.

1190. New Synthetic Processes for the Production of Motor Spirits. E. Vellinger. *Sci. et Ind.*, 1940, No. 290 bis (Supplement to *Revue Mécanique*, 37–43).—A brief review of the development of alkylation (*i.e.*, condensation of *iso*paraffins and olefines in the presence of sulphuric acid) is followed by a general survey of the processes involved. Each factor influencing the reaction—*e.g.*, *iso*paraffin : olefine ratio; time of contact; strength of acid, temperature, acid : hydrocarbon ratio, etc.—is assessed. Data are presented on the tests (including lead susceptibility) of charging stocks and of the resultant products. One interesting table gives the octane values of various fractions of a di*iso*butylene–*iso*butane alkylation product. According to this table the initial cut 50–65° C. had a knock rating of 92·2, the 98–105° C. fraction had the highest rating—namely, 97·5—and the lowest rating, 79·7, was recorded by the 130–145° C. fraction. The last few fractions show increasing ratings up to 87·3 for the final cut at 185–190° C. Alkylation plants constructed, under construction, and projected are tabulated. Among those under construction or projected, the largest is that of the Magnolia Petroleum Co. for Beaumont, Texas, which will have a daily production of alkylated aviation fuel amounting to 340 m.³. Of the others projected, or being constructed, the most important are three of 240 m.³ per day production—namely, at Baytown for the Humble Oil Co. and at Houston and Wood River for the Shell Co. The Standard Oil Co. are constructing one of 190 m.³ per day at Baton Rouge. The development of alkylation calls for increasing quantities of olefines, and

there has thus been a concurrent development of processes for the dehydrogenation of lower paraffin hydrocarbons to meet this demand. The dehydrogenation processes are outlined. T. C. G. T.

1191. Anti-Detonants in the Manufacture of Aviation Fuels. H. Guinot. *Sci. et Ind.*, 1940, No. 290 bis (Supplement to *Revue Mécanique*, 45–52).—The increasing demand for high-performance aviation fuels is emphasized by a table showing the percentages of various fuels consumed by the U.S. Army over the years 1932–1938. In 1932 they used 86% of 87-octane-value fuel and 14% with a 58–65 rating. In 1938 90% of their consumption was 100 octane fuel, and this amounted to about 700,000 hectolitres. The demand is increasing at an enormous rate, the consumption being probably quadrupled in three years. The efforts being made to meet demand are reviewed. Dopes such as lead tetraethyl and iron carbonyl, and synthetic fuels, such as alkylated and polymerized hydrocarbons, *iso*propyl ether, alcohols, ketones, and esters all receive attention. T. C. G. T.

1192. Patents on Motor Fuel. Standard Oil Development Corp. E.P. 521,786, 30.5.40. Appl. 11.4.39. Fuel for compression ignition engines of the diesel type consisitng of a hydrocarbon fuel and a small amount of an organic compound containing in the same molecule a diazo-group and a carboxyl group to impart better ignition qualities to the fuel.

L. A. Mekler. U.S.P. 2,203,833, 11.6.40. Appl. 30.9.32. Improvement in the method of heating light hydrocarbon oils of the character of naphtha and gasoline to effect their pyrolytic conversion. The oil, while substantially in liquid phase, is subjected to heating at a rapid rate, and thereafter at a decreased rate, and substantially completely vaporized during heating at the decreased rate. Afterwards it is again heated at a relatively rapid rate and the oil in vapour phase cracked.

R. Rosen. U.S.P. 2,205,107, 18.6.40. Appl. 23.10.35. Production of a motor fuel containing at least 25% of a polymer blend comprising di*iso*butylene and hydrogenated di*iso*butylene, the proportion of the latter being at least three times that of the former.

E. W. Thiele. U.S.P. 2,205,607, 25.6.40. Appl. 26.10.38. Conversion of wax into high-quality motor fuel by vaporizing and heating to a temperature between 850° and 1000° F. The heated vapours are then contacted with a catalyst comprising metal oxides and the reaction products fractionated into at least one gas fraction, a gasoline fraction, and a fraction heavier than gasoline. H. B. M.

Lubricants and Lubrication.

1193. Friction and Temperature as Criteria for Safe Operation of Journal Bearings. S. A. McKee. *Bur. Stand. J. Res.* (*Wash.*), 1940, **24** (5), 491–508.—One of the chief limitations of the science of journal-bearing lubrication in its present status is the difficulty of applying the results of experimental investigations directly to problems involving the performance of bearings in actual service.

This paper describes a method for the application of friction and heat-dissipation data to the determination of the load-carrying capacity of a journal bearing when operating with a lubricant of known characteristics. Two primary considerations are necessary: (1) that the bearing shall always operate in the region of stable lubrication; (2) that the bearing operating temperature shall never exceed some limiting value.

An equation for thermal equilibrium gives the relationship between the thermodynamic and hydrodynamic factors pertaining to journal-bearing lubrication. From this relation, pressure-speed curves representing the limits for safe operation are obtained by consideration of permissible values for temperature rise and the operating variable $\frac{ZN}{P}$.

An example of the application of this method is given with data obtained experimentally in laboratory apparatus with bearings and lubricant typical of some automotive installations. The method is also used to calculate the effects on the load-carrying capacity of the bearing of changes in the viscosity characteristics of the lubricant, critical $\frac{ZN}{P}$ value, ambient temperature and heat dissipation characteristics.

The practical application of the method is outlined for the case of automotive-engine bearings. D. L. S.

1194.* Fundamental Mechanical Aspects of Boundary Lubrication. H. Blok. *J. Soc. aut. Engrs*, 1940, **46** (2), 54–68.—The author's compromise classification of boundary lubrication based on two of the mechanical conditions discussed in the paper is distinguished by the following four main types.

Type I. Mild Boundary Lubrication.
Type II. High-temperature Boundary Lubrication.
Type III. High-pressure Boundary Lubrication.
Type IV. Extreme Boundary Lubrication.

Each of these types is discussed, and examples are given of occurrences in practice with reference to lubrication phenomena and processes and also to improvements to the lubricant and rubbing surfaces.

Thus Type I occurs under conditions of low pressure over a "dispersed" contact area, low temperature, and low sliding speed. Examples are low-speed sleeve bearings, and leaf springs. Greases are suitable lubricants for these conditions, and improvements in oils can be effected by the addition of polar agents.

Type II is subdivided. Thus Type IIA is characterized by high bulk temperature such as occurs in internal-combustion engines. Pressure is low and motion is of a sliding nature. Piston-ring lubrication is an example of this type. Improvement in the lubricant is difficult, inasmuch as the added dope must withstand high temperature, and the property of controlling wear may have to give place to subsidiary properties such as anti-ring sticking and stability.

Type IIB is characterized by high-temperature flashes on the surfaces of actual contact which are of a "dispersed" nature. Sliding speeds must be relatively high. The example given is that of fast-running sleeve bearings where there is actual contact between journal and bearing. Such conditions need a copious oil supply to reduce frictional heat and so minimize the danger of seizure. The lubricant for these conditions is improved by the addition of polar molecules.

Type III, High-pressure Boundary Lubrication, is not to be confused with what is commonly termed at present Extreme-pressure Lubrication, now classified as Type IV. Both types are characterized by "concentrated" contact. In Type III the mean temperature of the region of contact is by definition low. Examples are primarily of rolling contact, as in anti-friction bearings, and also spur gears where the actual contact is on the pitch circle. Oil is the choice for lubricant, since it will flush away worn particles, and so help to keep the surfaces true—a prime essential for this type of contact. Typical forms of wear are pitting and flaking, which may start below the surface as a result of over-stressing of the rubbing materials. In endeavouring to combat both the mechanical and chemical (oxidizing and nitriding) wear no improvement of the lubricant is possible.

Type IV is characterized by "concentrated" contact and high temperature, temperature flashes being especially characteristic. Highly loaded hypoid gears are a classical example. Prevention of seizure is a primary aim, and, as regards seizure, it is temperature and not pressure which is decisive. Design of gears and choice of materials according to their thermal properties will aid in reducing temperature flashes. The lubricant can be improved by the addition of dopes which are chemically active at the high local temperatures. The dopes should not be active at the bulk temperature of the oil in order that undue corrosion be prevented.

The various types of contact are analyzed and defined in an introduction to the paper, and an appendix deals with frictional vibrations under conditions of boundary lubrication. J. L. T.

1195. Studies in Lubrication. VI. Electrolytic Models of Full Journal Bearings. F. Morgan, M. Muskat, and D. W. Reed. *J. appl. Phys.*, 1940, **11**, 2, 141.—The theory, construction, and operation of an electrolytic model of a full journal bearing of journal displacement to radial clearance of 0·1 are described. The results are compared with those calculated from hydrodynamic theory, and agreement is obtained. The model is adapted to the care of bearings with sources of lubricant and circumferential grooves. P. D.

1196.* Historical Development of our Knowledge of Friction and Lubrication. G. Vogelpohl. *Oel u. Kohle*, 1940, **36**, 89–93, 129–134.—The development of theories of friction from the time of Leonardo da Vinci to the latter part of the nineteenth century is described. Numerous references are made to the original literature, and a table is given of the salient points of the theories of twenty-five authors. In the case of twelve of the more important, more detailed information is made available and illustrations are given of apparatus and diagrams from their publications. Reference is also made to work done on the physical nature of friction and to the development of mathematical theories. T. T. D.

1197.* Contribution to the Theory of Lubrication of Metal Surfaces at High Temperatures. D. Biro. *Bol. Inform. Petroleras*, Feb. 1940, XVII (186), 19–26.—This paper deals with the consumption of lubricating oil in aircraft engines. As is well known, the consumption of oil increases with the number of revolutions, and follows an exponential law. The question is treated mathematically, and includes a description of experimental work carried out in this connection. H. I. L.

1198. Patents on Lubricants and Lubrication. Standard Oil Development Co. E.P. 521,776, 30.5.40. Appl. 28.11.38. Improvement in production of addition agents for lubricating oils. The initial condensation product obtained by condensing halogenated aliphatic hydrocarbons or olefins with aromatic hydrocarbons is further condensed with a dicarboxylic acid halide.

E.I. Du Pont de Nemours & Co. E.P. 522,122, 10.6.40. Appl. 5.12.38. Preparation of lubricating materials having incorporated therein small proportions of entirely organic esters of branched chain aliphatic alcohols containing from six to nine carbon atoms with phosphorus or thiophosphorus acids.

E.I. Du Pont de Nemours & Co. E.P. 522,123, 10.6.40. Appl. 5.12.38. Preparation of lubricants having incorporated therein a small proportion of an alkyl thiophosphite containing at least one alkyl radical directly attached to a sulphur atom of the thiophosphite radical and containing one to six carbon atoms.

Standard Oil Development Corp. E.P. 522,189, 11.6.40. Appl. 2.5.39. Preparation of a lubricating composition containing a mineral oil and a soluble organic xanthogen tetrasulphide.

United States Rubber Co. E.P. 522,191, 11.6.40. Appl. 14.6.39. Improved lubricating oil or grease having dispersed therein a bis-alkyl xanthogene having at least three carbon atoms in the alkyl group and having a decomposition point of at least 150° C. whereby to increase the film strength of the oil at working temperatures.

B. H. Lincoln. U.S.P. 2,204,538, 11.6.40. Appl. 18.3.35. Preparation of a lubricant comprising a major proportion of a hydrocarbon oil and a minor proportion of the sulphurized esters obtained by esterifying with a monohydric or dihydric alcohol the fatty acids obtained from processing pine wood, and then sulphurizing these esters.

L. A. Mikeska. U.S.P. 2,204,609, 18.6.40. Appl. 26.9.36. Improving a naphthenic lubricating oil by the addition of a relatively small amount of an acyl halide. The resulting mixture is condensed in the presence of a catalyst of the Friedel–Crafts type.

C. F. Prutton and A. K. Smith. U.S.P. 2,204,620, 18.6.40. Appl. 26.7.34. Preparation of a lubricating composition containing a major proportion of mineral oil and a minor proportion of both a halogenated organic compound and a sulphurized mineral oil.

R. C. Cantelo. U.S.P. 2,204,660, 18.6.40. Appl. 24.1.38. Preparation of an improved lubricating oil containing a small proportion of thiobenzophenone.

J. M. Musselman and H. P. Lankelma. U.S.P. 2,205,172, 18.6.40. Appl. 26.11.37. Preparation of a lubricant containing a mineral lubricating oil and a small amount of a salt of an *N*-substituted-*p*-aminophenol and an organic carboxylic acid of at least six carbon atoms.

J. A. Wunsch and C. A. Marlies. U.S.P. 2,205,740, 25.6.40. Appl. 14.3.32. Preparation of a lubricant containing a major proportion of unchlorinated mineral oil and a smaller amount of a compound including a chlorinated fatty acid radical.

L. A. Mikeska. U.S.P. 2,205,858, 25.6.40. Appl. 23.1.32. Extreme-pressure lubricant composed of a mineral lubricating oil and a small quantity of polysulphides derived from mercaptans obtained in the refining of petroleum. H. B. M.

Gas, Diesel and Fuel Oils.

1199.* Relation between Engine Tests and Startability of Diesel Fuels. P. Weber. *Oel u. Kohle*, 1940, **36**, 78–89.—Since it is desirable to be able to rate the efficacy of diesel fuels in starting from cold, an investigation has been carried out on fourteen fuels to find what relationship there is between this property and cetane number as determined on the German War Office test engine. Three engines were employed, including both direct and indirect injection, and for the purpose of the test only one cylinder in each engine was used. The fuels were compared by the throttling method; at constant air temperature the air intake was throttled until ignition ceased to occur. Comparisons were effected by measuring the decrease of pressure in the intake line. Great care was exercised in keeping all working conditions constant, the temperature of the intake air being controlled by running the engines in a refrigerator.

The test engine was driven by an electric motor at 120 revs./min., and after 15 sec. fuel was injected for ten complete cycles, thereafter alternating three cycles with, and three cycles without, injection. From the indicator diagram and revolution counter the time of first ignition was observed. The process was repeated at various temperatures and the time to first ignition plotted against temperature. From the best curve through the points the temperature at which the engine started after thirty cycles was read off and taken as starting temperature. A number of these diagrams are given, showing the deviation from the mean to be expected; all were of similar shape, approaching the time axis asymptotically as the temperature decreased. Graphs are also shown of the relation of starting temperature to cetane number measured on the test engine; these are hyperbolic, and equations are given connecting starting temperature with cetane number. The departures from the curve were few, and the test mixtures of cetane and α-methylnaphthalene were also found to lie on this curve.

Tests were also run which showed that cetane number dopes such as amyl nitrate had not correspondingly good effects on the starting temperatures, so that the relationship established between the starting temperature and cetane numbers of diesel fuels does not hold if the latter are doped. T. T. D.

1200.* Influence of Dopes, Particularly Organic Peroxides, on the Ignition Qualities of Diesel Fuels. A. W. Schmidt and F. Mohry. *Oel u. Kohle*, 1940, **36**, 122–128.—High-grade diesel oils must be essentially paraffinic, hence, if aromatic distillates are to be used in C.I. engines, they must either be subjected to drastic refining, with consequent wastage, or treated in some other way to improve their cetane rating. Work on gasoline engines has shown the connection between the presence of organic peroxides and knock, so the effect of peroxides as cetane number dopes has been investigated. The authors divide organic peroxides into four groups: (1) H–O–O–H; (2) H–O–O–R; (3) R–O–O–R; (4) $\left[R\!<\!\begin{matrix}O\\O\end{matrix}\!>\right]_x$; and investigations were carried out with representatives of all four.

Engine tests were run on a single-cylinder diesel motor with variable compression,

and the variation of ignition delay with compression ratio was determined. Five series of experiments were run: (1) 2% solution of dopes in a diesel oil derived from lignite; (2) 1% solution of dopes in the same basic fuel; (3) 2% solution of dopes in another lignite diesel oil tested after storing for 10 months; (4) 2% and 1% solutions of dopes in a diesel oil derived from coal; (5) 2% solution of dopes in a commercial gas oil. A high-grade Iranian gas oil was also examined in each series as a control.

These series of experiments grade the peroxides in approximately the same order of efficiency; the dialkyl peroxides are most effective, followed by diacetone diperoxide; tetralin peroxide proved the least efficient. As an example of the efficacy of these dopes it may be quoted that the diesel oil derived from coal would not fire satisfactorily with a compression ratio less than 18 : 1, whereas on the addition of 2% diethyl peroxide similar behaviour was obtained with a ratio of 13 : 1. T. T. D.

1201.* Relation of Diesel Fuel Properties to their Engine Performance. W. S. Mount and G. A. Hope. *J. Soc. aut. Engrs*, 1940, **46** (3), 100–105, 136.—This paper represents a study of some of the fundamentals which might point to effective means of improving the performance of existing high-speed diesel engines. Only those problems which lend themselves to ready solution in the laboratory were attempted, and tests dealing with combustion-chamber deposits, gum formation, crankcase contamination, engine wear, and similar long-time investigations have been omitted from the discussion.

Seven high-speed engines were used in the work, ranging in size from 3 to 75 h.p. per cylinder, in order to cover a suitable cross-section of the types considered most critical from a fuel-requirement standpoint. Extensive data are given which show the effect of fuel characteristics on combustion and general engine performance, the effect of load and speed on sensitivity to fuel cetane number; and the influence of jacket temperature and injection timing on performance and cetane number requirement, in several types of engine.

It is concluded that although slight improvements in engine roughness are possible with high-quality fuels, the gain is small compared with that which might be obtained by minor design changes. Partial control of variations in ignition delay and combustion pressures caused by varying speed and load can be achieved by the use of higher than average quality fuels, but the control so obtained does not warrant the extra cost of such fuels. Test data indicate that a high combustion-chamber temperature should be maintained and operation at light loads should be carried out at jacket temperatures of 160° F. or higher. Every move towards higher combustion-chamber temperatures seems to improve the combustion process, and if this trend continues without great change in the injection process, it is predicted that very high-quality fuels as determined by cetane number and physical characteristics should take a less important place in future diesel fuel sales. C. H. S.

Asphalt and Bitumen.

1202.* Note on the Measurement of Flow Properties of Asphalts by the Penetrometer. C. C. Mill and V. G. W. Harrison. *J. Soc. chem. Ind.*, 1940, **59**, 66–67.—These authors state that the reasoning in the recent paper by C. Mack (*J. Soc. chem. Ind.*, 1939, **58**, 306) is mathematically unsound, and that the penetrometer equations are more complicated than would appear from his paper. They point out that if two asphalts have the same depth of penetration after a given time, it does not follow that their viscosities are the same, and from this show that Mack's equations are incorrect and their treatment not self-consistent, and hence the viscosity figures given appear unreliable. They also indicate that yield values cannot be obtained by Mack's method, but it is necessary to plot the rate of shear against shearing stress and find the load at which the rate of shear vanishes by extrapolation. H. G. W.

1203.* An Index of the Chemical Nature of Road Tars. T. H. Blakeley. *J. Soc. chem. Ind.*, 1940, **59**, 87–88.—An increase in the severity of the cracking of coal produces a tar which is more aromatic and has a higher specific gravity (s.g.). The s.g., however, depends on the viscosity, and both are necessary to define the tar. The

author derives values called " standard gravities " by giving the s.g. which, according to a graph of equiviscous temperatures (E.V.T.) *v.* s.g. for various tars, would be obtained at a fixed E.V.T. (30° is suggested). On this basis all coke-oven tars would have a value of 1·20 approximately. A table of conversion is given, together with suggested limiting values. H. G. W.

1204.* Study of Sieves for Coarse Aggregates. A. H. D. Markwick. *J. Soc. chem. Ind.*, 1940, **59**, 88–92.—Since it had been pointed out that there appeared to be discrepancies between woven wire and perforated plate sieves from ¼ to ¾ in., comparative tests were carried out, and it was found that the woven wire sieves were considerably less accurate in aperture size and shape. Owing to the use of crimped warped wires in manufacture, the openings were found to be trapezia with alternate short and long sides, and owing to the interweaving of the wires it was shown that particles of a larger size than the projected horizontal size could be passed through. The effective size was found to be 3–4% greater than that of a corresponding perforated plate. To offset wear during tests a very hard igneous rock with its edges rounded off was used, and tests of 5 min. duration were made on the woven and perforated sieves alternately. By means of sieving tests on hand-gauged samples of ¾-in. size the effective sizes of the two types of sieve were obtained. The differences between the effective size and the average projected aperture were then accounted for by correcting for the effect of the woven aperture and by making an allowance for the variability in aperture size. The rate of passage through both sieves was found to be practically the same. Flaky material was found to pass more slowly than cubic, and elongated material was very difficult to sieve. To avoid two discontinuities in the sieve series it is suggested that perforated plates only be used down to ⅛ in., where there is already a break in the sieve series, otherwise, if the change is made from perforated plate to woven wire before this, serious errors may arise in certain cases. H. G. W.

1205.* Research in Soil Stabilization with Emulsified Asphalt. C. L. McKesson. *Proc. Amer. Soc. Testing Mats.*, 1939, **39**, 1123–1133.—Soil stabilization with emulsified bitumen has come into extensive use only during the last five years. Prior to this some research studies had shown that the amount of emulsion required varied widely for different soils and depended on the consistency of the bitumen and type of emulsion. The development of test methods to measure the efficiency of stabilization was therefore necessary, since the usual methods of testing hydrophilic soil were unsatisfactory with the hydrophobic bitumen-covered soil. Two of the test methods, the absorption test and the test for stability, have been recommended as tentative standards. The present absorption test was developed from the simple soaking of stabilized samples in water and is described in detail, parallel tests being run on the stabilized and unstabilized soils. Compacted cylinders of 2 by 4 in. dried to constant weight at 140° F. are placed on heavy water-saturated cotton-flannel cloth and covered to prevent evaporation. Seven days was found to be sufficient to decide whether stabilization was effective or not, depending on the amount of absorbed water. The bottom ½ in. is used in the stability test and is fully saturated after this time. A properly stabilized specimen absorbs only 10–15% of the water absorbed by an unstabilized one, and the limit decided on was 12% of that in the untreated specimen plus 0·5%. For the stability test the compacted cylinders, after testing as above, are placed in the stability test apparatus and the saturated lower part extruded ½ in. through a circular orifice of 1 sq. in. The total load in lb. required is taken as the stability. These two tests have been universally specified since 1935 and have given every indication of the efficiency of a stabilization project. The height of the specimen does not appear to be critical, neither does wall friction. Loads up to 40,000 lb. are required and a minimum of 10,000 lb. is considered satisfactory. The plastic flow was found to be greatest in the centre of the specimen. A punching shear test is also described, which, it is thought, may bring out additional valuable information. The test methods are used to indicate the relative efficiencies of different types of emulsions and to determine the quantities required. As examples it is shown that a fine emulsion is much more effective than a coarse one and bitumen of 58 pen. 10% more effective than bitumen of 209 pen. H. G. W.

1206.* Evaluating the Adhesive Properties of Asphalt. A. Holmes. *Proc. Amer. Soc. Testing Mats.*, 1939, **39**, 1140–1149.—The "adhesivity" of an asphaltic bitumen is defined as its ability to resist being displaced by water from an aggregate. To evaluate this property the following tests have been used:

(*a*) The partition test, which measures the amount of non-oil-wetted material after shaking a mixture of fine aggregate, water, and asphaltic oil, is considered to give only very rough results.

(*b*) Various water-displacement tests, in which the aggregate is coated with bitumen and then subjected to the action of water at a given temperature, appear to give the most promising results. The author uses 20 hrs. soaking in distilled water at room temperature for uncured cutbacks, and at 140° F. for completely cured cutbacks and paving bitumens. A further accelerated test is to boil in distilled water for 1–5 min. The "adhesivity value" is the percentage remaining coated and is estimated visually.

(*c*) In the abrasion-displacement tests coated mineral aggregate is shaken under water in a can in a shaking machine until the test is completed, and is generally the time required to remove a given percentage—*e.g.*, 50%.

It is considered that test (*b*) gives the most indicative results, preference being given to that at 140° F., since (*c*) is subject to the errors of (*b*) as well as abrasive effects.

To obtain results of a more practical character circular track tests have been developed to a standard procedure, and details of its operation are given. The breakdown of the track is taken as the number of revolutions of the machine required to loosen 10% of the total bitumen-aggregate mixture laid. Between 78° and 90° F. there is a mean increase of 840 revs./degree decrease in temperature and at 90° F. an increase of 450 revs./degree rise in softening point, the track being run under water and continuously in each case. A correlation has been indicated between the results obtained on the circular track and the laboratory tests (*b*). By the use of suitable wetting agents, particularly heavy metal soaps, in the bitumen the track life has been increased up to 3·88 times that of the untreated bitumen. A considerable amount of work remains to be done to develop a small-scale quantitative laboratory test which can be correlated with road results. H. G. W.

1207.* Some Factors Affecting the Thermal Susceptibility of Asphaltic Paving Mixtures. R. Vokac. *Proc. Amer. Soc. Testing Mats.*, 1939, **39**, 1153–1157.—The compression test was used to measure the strength or stability of asphaltic bitumen paving mixtures because of the correlation obtained with the service performance of mixtures. Values were obtained at various temperatures with various mixtures using a hydraulic Baldwin–Southwark compression tester. Data are given showing the influence of mixture composition on the susceptibility of compressive strength to change in temperature and in asphalt cement; this thermal susceptibility was found to vary with variation in each of these three factors. In comparable mixtures it has been shown that the thermal susceptibility varies according to that of the asphalt cement. Although additional filler decreases the susceptibility of a given mixture, the effect is not so evident at low temperatures, and is also markedly influenced by the source of the asphaltic bitumen. It is therefore concluded that, in order to obtain mixtures having very similar physical characteristics, such as susceptibility, strength, etc., if bitumens from different sources are used, the mixtures must be made up to suit the individual characteristics of each bitumen. H. G. W.

Special Products.

1208.* Rubber from Petroleum. H. S. Norman. *Oil Gas J.*, 11.4.40, **34** (48), 9.—Plans for the commercial production of Buna rubber at Baton Rouge, La., are in the early stages of development, a plant with a daily capacity of 10,000 lb. synthetic rubber being considered. In modern practice it is derived from butadiene combined with acryl nitrile and styrene, and is claimed to have most of the desirable properties of natural rubber with a superior resistance to heat, abrasion, ageing, and swelling in

gasoline and oil. Butadiene may be produced by the catalytic dehydrogenation of *n*-butane to butylene at 25–80 lb./sq. in. and 900/1000° F., followed by conversion of the butylene at normal or reduced pressure and 1000/1200° F. After removal of the butadiene, the residual butylene may be polymerized, the unpolymerized hydrocarbons separated and re-circulated to the first step, and the butylene depolymerized and re-circulated to the second step. Butadiene is extracted from the liquid hydrocarbons with liquid ammonia or ethylene glycol or absorbed from the gases by acid cuprous chloride.

Butadiene is also derived from propylene or *cyclo*hexane pyrolysis at 450–800° C. under atmospheric or reduced pressure, the pyrolysis products being rapidly cooled to retard further reaction and to condense the hydrocarbons. Butadiene is separated by cooling and compression, by absorption in low cold test oil or solution in *e.g.* mercuric salt solution or liquid SO_2. It is almost invariably formed during pyrolysis of hydrocarbons at lower temperatures than those at which aromatic hydrocarbons are formed. Butadiene-1 : 3 is obtained by the catalytic dehydrogenation of butene-1 or -2 under controlled conditions, and isoprene from branched-chain pentenes. Once through yields of butadiene from *n*-butylenes varied from 20 to 30%, with ultimate yields of 80%. C. L. G.

1209.* Distribution of Nicotine between Water and Petroleum Oils. L. B. Norton. *Industr. Engng Chem.*, 1940, **32**, 241.—At the low concentrations used in insecticidal spray mixtures, nicotine is almost equally distributed between the oil and water phases. At intermediate concentrations the distribution is in favour of the water, reaches a maximum, and decreases at high concentrations. The presence of acids leaves any excess of free base equally distributed between the two phases, and when present in excess results in the complete extraction of the nicotine into the aqueous phase. At concentrations of less than 0·1*N* alkalis have no effect on the phase distribution, at higher concentrations they drive the nicotine into the oil phase, the extraction into the oil phase being complete with 5*N* sodium hydroxide. The result of these observations is that although it is highly desirable in insecticidal sprays that the nicotine should be concentrated in the oil phase, it is distributed equally between the oil and water phases independently of nicotine concentration, the presence of fungicides, and emulsifiers. Drying of the spray on the foliage concentrates the nicotine in the oil phase. J. W. H

1210.* Plastics and Resins from Hydrocarbons. P. K. Frolich. *Industr. Engng Chem.*, 1940, **32**, 293.—The magnitude and comparative rates of growth of the production of resins from coal tar and non-coal tar sources are reviewed. It is concluded that, although the quantity of non-coal tar resins is only one-eighth of the total synthetic resin production, it is a very rapidly expanding product. A list is given of the hydrocarbons which are used in the production of synthetic resins and rubber. J. W. H.

1211.* Propane Precipitation of Petroleum Resins. P. T. Graff and H. O. Forrest. *Industr. Engng Chem.*, 1940, **32**, 294.—Propane precipitation of petroleum resins is used commercially to reduce the duty of clay in decolorizing lubricating-oil stocks. The de-resinification process follows the conventional propane deasphalting treatment, in which asphalt precipitation takes place with six volumes of propane at 100° F. After removal of the asphalt, a further 200 volumes of propane are added and the temperature is raised to 140° F., when the primary resins are precipitated. These resins are washed free of oil with propane, or may be fractionated into washed resins and high- and low-viscosity stocks by the application of a temperature gradient to the propane washing treatment. J. W. H.

1212.* Polybutenes. R. M. Thomas, and others. *Industr. Engng Chem.*, 1940, **32**, 299.—The polymerization of butenes at low temperatures yields high-molecular-weight polymers, which vary from viscous liquids to elastic solids. These polymers are chemically inert and stable in character. The technique employed in the determination of the molecular weights of these polymers is described. The addition of polybutene to cellophane is shown to increase the impermeability to water vapour.

The addition of 25% Exancl (a 15,000-molecular-weight polybutene) to a low viscosity and low V.I. lubricating oil, results in the production of an extremely viscous (3180 secs. Saybolt at 210° F.) lubricating oil, possessing a V.I. of 130. Viscosities of 14,000 secs. Saybolt at 210° F. may be obtained by the addition of only 5% of a 73,000-molecular-weight polymer to a low viscosity base stock. These very high-molecular-weight polymers impart a stringy character to the product, which is of value in reducing oil leakage in open-type bearings and in any place where excessive oil must be avoided. By the addition of small amounts of polybutenes, the properties of asphalt may be modified appreciably, the softening point and penetration are increased, and the slope of the penetration–temperature curve lowered. The addition of polybutene to paraffin wax increases the viscosity of the wax, the low-temperature flexibility and the bonding properties. J. W. H.

1213.* Production of Petroleum Resins. S. C. Fulton and A. H. Gleason. *Industr. Engng Chem.*, 1940, **32**, 304.—Resins can be produced from cracking coil tar by three methods :—

(*a*) The cracking coil tar is reduced in a high vacuum to produce a residue having a softening point of 110° C. This residue is extracted with a refined petroleum distillate (*e.g.* Varsol). The suspension of finely divided asphaltenes is filtered off and the solution of resins treated with sulphuric acid and clay. The resin is finally recovered by distillation of the solvent. The yield of resin on the original tar is approximately 7%.

(*b*) The tar is distilled to a low-melting-point pitch, which is treated with aluminium chloride. This treatment causes coalescence of the dispersed asphaltenes (which are filtered off), as well as the formation of additional resins. After acid and clay treating the aluminium chloride treated tar, the resins are recovered by distillation under high vacuum. A yield of 11% resin on the reduced tar may be obtained by this method.

(*c*) The distillate from cracked petroleum tar is chlorinated and the product heated to 350° C. under vacuum to remove the overhead products (hydrochloric acid and oily materials). The residue is treated with naphtha and the hydrocarbon insoluble material separated from the resins, which are recovered by distillation of the solvent. A resin yield of 15% on the tar distillate is obtained. This process may be modified by the treatment of the chlorinated tar with a condensing agent to increase the yield of resins.

Resins can also be produced by the catalytic polymerization of cuts from light petroleum aromatic extracts with formaldehyde. These resins are pale yellow in colour, brittle, and behave well when used in the preparation of paints and varnishes. J. W. H.

1214.* Phenolic Compounds from Petroleum Sources. E. Field, F. H. Dempster, and G. E. Tilson. *Industr. Engng Chem.*, 1940, **32**, 489.—A historical summary is presented of the occurrence and nature of phenolic materials, together with their properties, which may be recovered from petroleum sources. Light, medium, and heavy grades of phenolic compounds derived from petroleum have been subjected to careful fractionation and the large number of fractions obtained analysed. The fractions were collected in 3° C. cuts and the physical chemical and germicidal properties of the cuts obtained. The various fractions were finally analysed for individual phenolic compounds according to the neat up-to-date methods in the literature, the analyses being on a quantitative basis. Comparative data were also obtained on a commercial grade of cresylic acid derived from a coal-tar source. The following phenols were identified, *o*-, *m*-, and *p*-cresol, 1 : 4 : 2-xylenol, 1 : 3 : 4-xylenol, 1 : 2 : 3-xylenol, 1 : 3 : 5-xylenol, 1 : 2 : 4-xylenol, *isopseudo*cuminol and 1 : 3 : 5-methylethylphenol. H. E. T.

1215.* Naphthenic Acids from Gulf Coast Petroleum. R. W. Harkness and J. H. Bruun. *Indust. Engng Chem.*, 1940, **32**, 499.—A complex mixture of naphthenic acids has been isolated from Gulf Coast petroleum, by distillation of the lubricating oil fraction over sodium. The naphthenic acids were thus concentrated in the residue as sodium naphthenates from which they were liberated by acid treatment. The

crude acids were further purified by treatment with alcoholic potassium hydroxide, and the hydrocarbon impurities extracted from the alcoholic solution by means of liquid butane at 70–90° C. in a pressure extractor. The oil free soaps thus obtained were treated with dilute sulphuric acid to liberate the pure mixed naphthenic acids which had a saponification and acid number of 166. The crude acids were separated into three cuts by distillation and each cut further divided into six fractions by distillation in a molecular still. Molecular weights were determined on the fractions by the cryoscopic method in benzene; in addition the saponification number, acid number, bromine number, CO_2H groups per mol., and ultimate analysis were carried out.

From the data accumulated it is concluded that—

1. The specific gravities of the naphthenic acids derived from Gulf Coast petroleum decreased with increase in molecular weight.
2. The higher boiling naphthenic acids are of the monobasic type.
3. The average empirical formulæ indicate that the composition ranges from $C_nH_{2n-4}O_2$ up to $C_nH_{2n-10}O_2$, the average number of carbon atoms in the molecule being 14 to 29. H. E. T.

1216.* Conversion of Naphthenic Acids to Naphthene Hydrocarbons. G. E. Goheen. *Industr. Engng Chem.*, 1940, **32**, 503.—A fraction of naphthenic acids isolated from the lubricating oil portion of a Gulf Coast crude petroleum has been investigated in detail. The isolated naphthenic acids had an average molecular weight of 317 and an average molecular formula of $C_{23\cdot7}H_{35\cdot2}O_{2\cdot1}$. The crude acids were converted by way of ethyl esters, alcohols, and iodides to the corresponding naphthene hydrocarbons, which were found to possess higher viscosity indices than naphthenes from a typical naphthene-base oil.

The crude naphthene hydrocarbons were refined by treatment with concentrated sulphuric acid and a portion was hydrogenated in a methyl*cyclo*hexane solution on a Raney nickel catalyst in an Adkins apparatus at a temperature of 230–250° C. and a pressure of 2700–3000 lb. per square inch hydrogen pressure. Physical properties of the products are reported.

After refining with sulphuric acid, the naphthene hydrocarbon had a kinematic viscosity index of 30, a viscosity gravity constant of 0·8604, a gravity index of 55 and kinematic viscosity of 13·41 centistokes at 100° F. and 2·72 centistokes at 210° F.

From considerations of the properties of the naphthenic hydrocarbon before and after hydrogenation, it became apparent that the deficiency in hydrogen in the naphthenic acids from which they were derived was to only a small proportion of aromatic material. Evidence obtained indicated that the acids were mainly polycyclic naphthenic acids with an average of 2·6 rings per molecule. H. E. T.

1217.* Naphthenic Acids (Aruba Acid). J. R. M. Klotz and E. R. Littmann. *Industr. Engng Chem.*, 1940, **32**, 590.—Aruba naphthenic acid is extracted from Colombian gas oil with dilute sodium hydroxide and recovered from the alkaline solution by acidification with sulphuric acid. A typical Aruba naphthenic acid has the following typical analysis:

Sp. Gr. (° A.P. 1)	15·7 (0·961)
Acid Number	202
Saponification Number	208
Iodine Number	4·1
Unsaponified material, %	13·5

A sample of Aruba acid was fractionated and 10% fractions were obtained, with a 20% residue. The phenol content of each fraction was determined, as well as the effect of each fraction on the air oxidation of benzaldehyde in the presence and absence of manganese naphthenate catalyst. Further, some characteristics of the acids in each fraction were determined.

It has been shown that phenolic compounds occur mainly in the low- and high boiling ends of Aruba acid, and that the intermediate fractions contain only relatively small proportions of phenols. From the experimental results obtained it appears

that the general use of the acid number as a criterion for the purchase on evaluation of naphthenic acids does not give sufficiently detailed information to be of much value to the consumer. H. E. T.

1218. Formaldehyde from Methane. Anon. *Chem. Tr. J.*, 7.6.40, **106**, 353.—A claim is made in E.P. 520,080, granted to Gutehoffnungshütte Oberhausen A.-G. for the production of formaldehyde by the partial oxidation of gaseous or vaporous hydrocarbons, of the acetylene, ethylene, or methane series, in the presence of small quantities of nitric or nitrogen oxides and solid catalysts (Si, Zn, Mg, Ti, Ce, etc.) in the form of oxides. A mixture of 49·8% by volume of a gas separated from coke-oven gas (containing 41% of methane), 50% of air, and 0·2% of nitrogen oxides, is passed at a rate of more than 75 cm. per sec. through reaction ducts lined and charged with solid oxide catalyst and heated to 620° C. The reaction gases are circulated several times, the yield being 560 gm. of 100% formaldehyde per cu. metre of methane. C. L. G.

1219. Patents on Special Products. Isidor Morris Koilbron. E.P. 521,749, 30.5.40. Appl. 25.10.38. Manufacture of new pyridyl phthalic acid derivatives by the interaction of pyridine with a diazotized aminophthalonitrile, aminophthalimide, or aminophthalic dialkyl ester which is in aqueous solution.

May and Baker, Ltd. E.P. 521,821, 31.5.40. Appl. 28.11.38. Preparation of *p*-aminobenzene-sulphonamido-derivatives of glyoxaline by the condensation of an amino-derivative of a glyoxaline with a benzene-sulphonyl halide or anhydride containing in the *para* position an acyl-amino-group which is then converted into an amino-group by hydrolysis.

Charles Pfizer and Co. E.P. 521,831, 31.5.40. Appl. 28.6.39. Conversion of esters of 2-keto-hexonic acids into the corresponding ascorbic acids by treating esters of the 2-keto-acids in aqueous solution in the presence of a metal selected from the group consisting of magnesium, iron, nickel, cobalt, manganese, cadmium, and zinc.

Karnbolaget Aktiebolag. E.P. 521,944, 5.6.40. Appl. 12.9.38. Manufacture of thio-esters by the addition of a thiocarboxylic acid to an unsaturated organic compound or to a mixture of such compounds.

Deutsche Hydrierwerke A.-G. E.P. 522,033, 6.6.40. Appl. 2.12.38. Manufacture of high-molecular ketenes. Halides of aliphatic or *cyclo*aliphatic monobasic carboxylic acids having at least six carbon atoms in the molecule are treated with strong tertiary bases.

J. G. Fife. E.P. 522,151, 11.6.40. Appl. 1.12.38. Preparation of improved textile oils comprising a mixture of a mineral oil and higher aliphatic alcohols or ketones having more than 8 carbon atoms in the molecule and a small proportion of a sulphated or sulphonated compound which reduces the surface tension, *e.g.* sulphuric acid ester salts containing higher alkyl radicals or alkali sulphonates derived from mineral oil sulphonic acids.

The Distillers Co., Ltd. E.P. 522,234, 12.6.40. Appl. 10.12.38. Conversion of olefines into olefine oxides by direct oxidation with the aid of a catalyst. The catalyst is composed of substantially pure silver in finely divided condition, and is supported on a metal support in intimate admixture with an inert filler or solid diluent material.

N.V. de Bataafsche Petroleum Maatschappij. E.P. 522,450, 18.6.40. Appl. 8.12.38. Improved process for the removal of acid components from hydrocarbons or derivatives thereof by extracting with an aqueous solution of an alkali metal.

J. Winkler. E.P. 522,451, 18.6.40. Appl. 8.12.38. Preparation of hydrocarbons from acid-refining waste by neutralizing by the dry method in an oil solution with exclusion of water. Neutralization is effected under pressure in a closed vessel at a temperature above 100° C., and only solvents rich in unsaturated and aromatic hydrocarbons are used for acid refining the waste.

B. T. Thurman. U.S.P. 2,204,109, 11.6.40. Appl. 6.10.38. Separation of minor constituents including phosphatidic material from vegetable oils containing same without destruction of the phosphatidic material. A small proportion of a solution of hydrogen peroxide is mixed with the oil to precipitate the minor constituents, which are afterwards separated from the oil by difference in specific gravity.

R. L. Humphreys. U.S.P. 2,204,597, 18.6.40. Appl. 23.2.37. Preparation of a compounded mineral oil containing a metal salt of an organic acid in sufficient amount to render the oil corrosive to bearing metals, and an organic ester having an unsaturated carbon to carbon bond conjugated with a carboxyl group of the ester. The organic ester is present in sufficient amount to reduce the corrosivity of the compounded oil.

R. L. Humphreys. U.S.P. 2,204,598, 18.6.40. Appl. 23.2.37. Preparation of a compounded mineral oil containing a metal salt of an organic acid and an organic ester of a polycarboxylic acid having two carboxyl groups no more than two carbon atoms apart in sufficient amount to reduce corrosivity of the compounded oil.

F. W. Kavanagh, V. N. Borsoff, and R. L. Humphreys. U.S.P. 2,204,601, 18.6.40. Appl. 23.2.37. Manufacture of a compounded mineral oil containing an addition agent in sufficient quantity substantially to increase the corrosivity of a mineral oil, and a small amount of an organic hydroxyl ester in an amount sufficient to reduce corrosivity of the oil.

F. R. Moyer. U.S.P. 2,204,967, 18.6.40. Appl. 25.9.33. Method of lowering the pour point of waxy mineral oils by incorporating therewith the active substances separated from pyrogenous condensation products from mineral oil by precipitation with an aliphatic solvent.

F. M. Clark. U.S.P. 2,205,187, 18.6.40. Appl. 31.7.36. Purification of a liquid halogenated hydrocarbon containing unfilterable finely divided carbon by dispersing in it a dilute aqueous solution containing at least 3% by weight of salt producing polyvalent cations.

H. Hopff and H. Schoenherr. U.S.P. 2,205,408, 25.6.40. Appl. 29.5.39. Preparation of fluorescent compound containing a hydrocarbon oil and a small percentage of a fluorescence-exhibiting condensation product obtained by heating an aromatic ketone having at least four condensed rings with an anhydrous halide of a metal selected from the group of zinc, beryllium, and aluminium. H. B. M.

Detonation and Engines.

1220.* Some New Investigations on Old Combustion-Engine Problems. G. Eichelberg. **Parts I–V.** *Engineering*, **148** (3850, 3853, 3855, and 3858), 463–466, 547–550, 603–606, and 682–686, and **149** (3871), 297–399.

Parts I–III. *Heat Flow in Cylinder Walls and Pistons and Temperature Effects.*—The heat flow in cylinder walls and pistons is examined both from the theoretical and experimental aspects. The varying temperatures of the cylinder gases are deduced, and from the given data on the heat transfer to the cooling water, the distribution of temperature is estimated.

The differential equation for periodic heat-flow is given from which the surface temperature fluctuations are calculated. The thermocouples used for the experimental measurements are described and the method is given by which the surface temperature variations can be obtained from the readings of thermocouples which are located a small distance beneath the surface.

From a knowledge of the heat transmission from the gases to the combustion chamber surface, and from the piston to the cylinder liner, the temperature distribution and fluctuation in the piston can be arrived at. The author includes measurements of piston and piston-ring temperatures at various points to produce the diagrams illustrating temperature fields, and data are given for both two- and four-stroke engines. The effect of the heat conductivity of the piston and cylinder materials is included.

The stresses produced by the temperature gradients and cyclic temperature variations are calculated for straightforward cases.

Data are given for exhaust-valve temperatures, and the cooling effect through the seat and stress is examined. Diagrams are given showing the temperature distribution and cyclic variation of temperature at different points of an exhaust valve.

Part IV. (a) *Entropy*; (b) *Fuel Injection*.—The use of the entropy diagram in studying combustion problems is put forward and is illustrated by an examination of a Büchi supercharged engine.

Types of fuel-injection pumps and nozzles are described, together with the advantages and disadvantages of the various systems. Some notes on a system which gave satisfactory results with petrol injection at high speeds are given.

The problem of nozzle carbonisation is also discussed.

Part V. (a) *Piston-ring Problems*; (b) *Practical Applications*.—The problems of blow-by and friction in piston rings are discussed, and the results of experimental investigations are given.

Some practical applications of experimental results in modern engine development are mentioned, and in particular the Pescara free piston generator is cited.

J. G. W.

1221.* Use of Gas as a Fuel for Motor Vehicles. J. S. Clarke. *J. Inst. aut. Engrs*, 1939, **8**, No. 2, 43–76.—This paper gives details of experiments carried out by the City of Birmingham Gas Committee since 1931. The author first deals with thermodynamic and mechanical problems which arise in compressing town's gas to a pressure of 5000 lb. per square inch, and special items of equipment needed for vehicles running on compressed gas, such as gas cylinders, reducing valves, gas mixers, etc., are dealt with from the point of view of the most satisfactory designs and layout on the vehicle.

For similar engines of the same compression ratio running on petrol and gas fuel the optimum power output on gas is approximately 88% of that obtainable on petrol. Data relating to bench tests made on a 20-h.p. Austin engine show the improvement in power and brake thermal efficiency effected by increasing the compression ratio from 4·6 to 5·6 to 1, and analyses of the exhaust gases show that no carbon monoxide was present.

The loss in power when using gas fuel results in poorer acceleration. Tests made on two 6-cylinder Guy buses, one using petrol and the other running on gas, are described, and it was found that by increasing the compression ratio of the gas-driven engine, acceleration in third gear was nearly equal to that obtained with the petrol vehicle. Gas consumption figures for various vehicles are also given.

Experimental work with a Belliss & Morcom 4-stroke vertical 2-cylinder engine of 3-$\frac{5}{8}$ in. bore × 5 in. stroke using gas injection and spark ignition, or compression ignition to determine the maximum compression ratio which could be used before pre-ignition developed showed that (1) gas consumption could be reduced by more than 30% when using a compression ratio of 15 : 1 as compared with a ratio of 7 : 1; (2) gas could be used without pre-ignition up to compression pressures of 600 lb. per square inch—*i.e.*, 17 : 1 compression ratio; (3) more power was developed at 900 r.p.m. on gas than on fuel oil, the outputs being 10·29 h.p. and 8·6 h.p.; (4) it was impossible to obtain self-ignition of coal gas at a compression ratio of 17 : 1, which eliminated the possibility of running small-bore engines on self-ignition principle.

Appendices deal with the calculation of calorific value of compressed gas and estimated costs of a compressed gas scheme for a fleet of buses. C. H. S.

1222.* 1939—Bulletin. Diesel Engine Users Association.—The latest annual bulletin of the D.E.U.A. is less comprehensive than usual, owing to inevitable war-time restrictions. Nevertheless, it remains a valuable survey of diesel developments in 1939, in the fields of road and rail traction as well as stationary and marine installations. The general tendency for land power has been to increase B.M.E.P., and pressure-charging is being increasingly used. There is a growing interest in engines capable of running on gas and oil fuel alternatively. For marine purposes the chief types built comprised 4-stroke single-acting supercharged, 2-stroke single- and 2-stroke double-acting. Developments in diesel rail traction have been most marked in the Americas, Denmark, Holland, and Italy. Few, if any, major changes have taken place in road transport. K. A.

1223.* Modern Aircraft Valves. A. T. Colwell. *J. Soc. aut. Engrs*, 1940, **46** (4), 147–165.—This paper is a survey of development and current practice in regard to aircraft-engine valves, both in America and Europe. The ability of the modern valve to withstand arduous conditions is attributed to three major developments: sodium cooling, forging technique, and cylinder-head design. Much information is given concerning materials and methods of manufacture employed by the leading engine-builders of both continents, and the paper is comprehensively illustrated. K. A.

1224.* Aircraft Spark-Ignition Engines with Fuel Injection. O. W. Schey. *J. Soc. aut. Engrs*, 1940, **46** (4), 166–176.—The National Advisory Committee for Aeronautics has conducted a large number of tests on single-cylinder engines using fuel injection and spark ignition; three of these were water-cooled and three were air-cooled. Four types of injection pump were used, of which one was a diaphragm type of N.A.C.A. design. Four designs of injection valve were tested.

It was found that performance is not critically sensitive to injection valve location, start of injection, or injection period; maximum power and best economy are generally obtained when the fuel-injection period occupies that part of the cycle preceding the point at which combustion air is entering the cylinder at maximum rate. The fuel spray should be directed in a horizontal plane against the incoming air. Varying the injection-valve opening pressures from 300 to 3000 lb./sq. in. gave no measurable change in engine performance.

Comparative tests of carburettor, cylinder injection and manifold injection showed that m.e.p. closely follows the volumetric efficiency, which is greatest at high speeds when the cylinder-injection method is used. Minimum specific fuel consumption was the same with each method of mixing the fuel and air. By using a valve overlap of 120–130°, a four-valve cylinder can be completely scavenged with 3 to 5 in. Hg pressure difference when fuel injection is employed.

Tests were made using "safety" fuels of volatilities ranging from 205–330° F. to 400–635° F. It was shown that increasing the distillation temperature has only a negligible effect on performance up to the range 350–500° F. The distillation temperature at which performance starts to fall off is approximately the same as the cylinder head temperature. Starting a cold engine with safety fuel is difficult, unless gasoline is supplied to the priming system. Another method which proved successful was the use of propane. K. A.

Coal and Shale.

1225. Low-temperature Carbonization: A Novel American Method. Anon. *Chem. Tr. J.*, 24.5.40, **106**, 330.—The *Colliery Guardian* for 12th May gives an account of a paper to the American Institute of Mining and Metallurgical Engineers by C. E. Lesher describing the Disco process for the production of low-temperature coke in ball form from coal dust (below $\frac{3}{4}$ in. size). A plant is in operation at Pittsburgh of capacity 7000 tons per month of low-temperature coke and 140,000 gals. of tar. The raw coal is first partly oxidized, to reduce the agglutinating properties, for about 2 hr. in horizontal cast-iron hearths, the coal being stirred and conveyed by rabble arms. Coal is transferred from the roaster at 600° to a reservoir, where it is kept hot by heating gas in ducts and mixed before transfer to the carbonizers. These consist of inclined rotating steel cylinders surrounded by an insulated stationary shell. Heating gases are passed through the annular space. Into the upper end of the revolving retort are introduced coal and a definite proportion of below $\frac{1}{4}$ in. preheated coke breeze, the low-temperature coke being discharged from the lower end in the form of balls. Cooling of coke balls below 2 in. diameter is effected by water, but smaller sizes are cooled in air, as water-cooling causes shrinkage cracks which destroy the structure. The Disco coke is dense grained and black, consisting of irregularly rounded balls or fragments of balls. The shatter index is above 70% retained on a 2-in. screen.
C. L. G.

1226. Patent on Coal and Shale. George William Johnson. E.P. 522,096, 10.6.40. Appl. 10.3.38. Process for the pressure extraction of coals which comprises the

employment as an extraction agent of an oil fraction of a medium boiling range, containing not more than 10 gm. of hydrogen for 100 gm. of carbon, together with less than 20% of an oil of a similar boiling point containing at least 14 gm. of hydrogen for 100 gm. of carbon. H. B. M.

Economics and Statistics.

1227.* Rumanian Petroleum Exports during the First Three Months of 1940. Anon. *Monit. Pétr. roum.*, 1940, **41**, 605–608.—In the first three months of 1940 Rumania exported 823,507 tonnes of petroleum products, against a figure of 1,130,757 in 1939. These exports are analysed and tabulated according to the country and destination, their value, and the balance of trade with the countries concerned.

The most notable feature of the analysis is that England has increased her percentage takings of the oil exported—*i.e.*, 19·57% to 38·49% or from 221,246 tonnes to 316,996. Germany and Italy, however, have both taken less. Thus, Germany received in the period under review 75,254 tonnes, or 9·14%, instead of 182,790, or 16·17%, in 1939. Italy received 83,436 tonnes, or 10·13%, instead of 172,352, or 15·24%, in 1939.

France received 4·24% of the exports instead of 5·24% in 1939, but Turkey shows a very big increase, from 0·73% in 1939 to 7·05% this year.

Of the 823,507 tonnes of petroleum export reviewed, 367,111 were gasoline, 139,919 kerosine and white spirit, 140,115 gas oil, and 132,296 fuel oil.

The article also tabulates the individual companies supplying the export demands. T. C. G. T.

1228.* National Supply of Fuels. Anon. *Bol. Inform. Petroleras*, Feb. 1940, XVII (186), 15–18.—A recent publication of statistics by the Institute of the Study of Transport Economics containing figures referring to consumption, import, and national production of fuel, including coal, petroleum, and alcohol, appears to have led to erroneous conclusions for which there is no justification. This article deals fairly fully with the position as it is affected by the present war, and compares the present situation with that which obtained in 1914. It is shown that in the latter year the total consumption of fuel was 2,901,603 tons, of which 84·5% was imported, whereas in 1939 the total consumption was 7,138,940 tons, of which 57·7% was imported. From the figures given it appears that the increased fuel consumption noted between 1914 and 1939 has been to a great extent met by the increase of petroleum produced within the country. H. I. L.

1229.* Adequacy of the Supply of Petrol for the whole of the Republic. Y.P.F. *Bol. Inform. Petroleras*, Feb. 1940, XVII (186), 14.—The Y.P.F. publish a notice giving an assurance that in spite of present difficulties in obtaining regular supplies of foreign products they are prepared to provide all the petrol that may be required in the country from the Government and private refineries. The public need therefore have no anxiety regarding the supply of petrol and, moreover, should a private company run short of petrol temporarily in any particular part, the Y.P.F. and its branches will meet their needs without delay. H. I. L.

1230.* Summary of the Work Carried Out in Refining Plants in the Argentine Republic during the year 1938. Anon. *Bol. Inform. Petroleras*, Feb. 1940, XVII (186), 27–29.—This summary includes three tables. One contains a census of works, number of employees, number of workmen, compared with the two previous years and similar comparative data showing expenditure on labour, material and power supply. Table II deals in detail with the materials used for treatment of the petroleum in the refineries, and Table III provides particulars of the various products, both as regards quantity and sale values. H. I. L.

BOOK REVIEW.

Geology of Eastern Iran. By F. G. Clapp. (*Bulletin of the Geological Society of America*, Vol. 51, 1940.) Pp. 101; 13 Pls.; 8 figs. Published by the Society, 50 Church Street, New York, N.Y.

The liquidation of the Amiranian Oil Co. has enabled its geologists to publish the general results of their surveys much earlier than had at one time been expected. Dr. Clapp's paper—the first, it is hoped, of a series of Amiranian origin—is a pioneer attempt to put down the high lights of a large tract of country the geology of which has been little more than an intriguing mystery for many decades. Those familiar with the delights of Iranian geology will not be deceived by the simple manner in which he presents his facts. They can appreciate the tremendous volume of travelling and field-work involved, often under conditions with which our more domesticated geologists are unfamiliar, and they will sympathize with the author in his formidable task of compiling and correlating such a mass of data. His own modest remark that his paper forms a "necessary background" for anything which may subsequently be written about Eastern Iran will be cordially endorsed by all who know the country.

With felicitous and characteristic astuteness, Dr. Clapp has disarmed possible critics in advance by confining himself rigidly to facts of observation and abstaining from all forms of deduction and theorizing. This is perhaps a pity, for his is an experienced and rational mind, and a few reflections on the geological history of his area, from a man of his calibre, would have garnished the almost Spartan fare of his facts.

On the structural side, he is content to present his observations and to leave the reader to reach his own conclusions, stimulated only by a brief reference to the views of the various authorities of earlier vintage—Suess (E.), Argand, Suess (F. E.), and de Böckh, Lees, and Richardson. On one point, however, it may be fairly observed here that his "true nappes of the Alpine type" (page 17 and Fig. 3, page 18) would scarcely be accepted by the Alpine school. It may be that these published profiles do not go deep enough to bring this feature out, but, on the other hand, it can safely be said that they bear little resemblance to the genuine decken of the Zagros country along the southern edge of the Iranian Plateau. A revision of Riviere's cross-sections of the Central Elburz may be forthcoming when the results of the survey work now being carried out by the Imperial Government are published. As seen on the ground, the profiles certainly do not suggest nappes.

A great wealth of stratigraphical knowledge is presented from the Elburz to Zahedan and Afghanistan, and no later revision of detail will impair the great value of this compilation for future investigators. Here again, however, it is felt that Dr. Clapp has perhaps been rather cautious and that a correlative summary of each formation—manifestly possible in some cases, at least—would have brought his great mass of stratigraphical information into better focus for his readers.

Pre-Devonian rocks appear to be as poorly developed in Eastern Iran as they are elsewhere in that country, but the Upper Palæozoic is well authenticated, even if the actual boundaries everywhere from Devonian to Trias are not always clear. Again, as elsewhere, the Trias is generally difficult to identify, unless in a calcareous facies, but the Jurassic attains considerable thicknesses on occasion, and its economic importance as the source of Iran's coal supplies (Lias) might have been given greater prominence by someone less interested in the rival form of fuel. The Cretaceous, at all times one of the most restless formations in the country, is well treated here, and perhaps it need only be added that the suspected volcanic phase between Lias and Cretaceous (page 54) can be clearly seen in the Central Elburz near Lahr, where, in several places, a variable thickness of green and red volcanic ash and tuff overlies now Lias, now Jura Limestone, and is in turn covered by dark

massive limestone with abundant Aptian Orbitolinas. The history of the vast and confused Tertiary basins is obscure. Work recently carried out in the Central Elburz by the Imperial Government shows that the "Green Beds" penetrate deeper into the column than had hitherto been believed—for example, in the high country north of Lahr the succession in ascending order is: (i) Orbitolina limestone, (ii) (andesitic) lavas, (iii) a mixed series of pyroclastics and (Middle) Eocene limestones, (iv) a considerable thickness of "Green Beds," (v) a second Nummulitic series the assemblage of which has not yet been worked out. The geological study of these Tertiary basins would be a fascinating exercise, but it lacks a commercial incentive at the present time.

It was perhaps too much to hope that Dr. Clapp would let fall from the rich table of his journeyings in Amirania some crumbs of interest to his fellow oil-men. He has, however, done the next best thing, and purveyed a sound and comprehensive factual report; and, for that, they are heavily in his debt. G. M. SHAW.

BOOKS RECEIVED.

The Mexican Oil Seizure. D. R. Richberg. Pp. 56. Standard Oil Co. (N.J.), 30 Rockefeller Plaza, New York City.

Mr. Richberg acted as counsel for the Oil Companies involved in the Mexican expropriation of foreign-owned oil properties, and in this pamphlet he endeavours to portray accurately the events leading up to the expropriation as well as the subsequent negotiations. To aid the reader in a clearer understanding of the position, the author devotes some pages to the historical background and describes the progress of the revolution in Mexico since 1913.

The writer offers no solution to the problem as it exists at present, apart from those already sought in vain, but, in his own words, has written this narrative "to aid in public understanding of the causes of a continuing controversy of profound interest" so that . . . "in the long run public opinion adequately informed should arrive at a sound judgement of what ought to be done."

Present Status of the Mexican Oil "Expropriations" 1940. Pp. 79. Standard Oil Co. (N.J.), 30 Rockefeller Plaza, New York.

The attempt of Mexico to confiscate the subsoil petroleum is not new, various devices having been tried to accomplish this since 1917. The United States has, however, uniformly resisted the effort, and the record of that resistance is set out in this memorandum. During the past year the Oil Companies have endeavoured to negotiate a private settlement with the Mexican Government, and a brief record of the negotiations is also given. The memorandum endeavours to show that the unsuccessful termination of the private negotiations now requires the interposition of the United States Government to secure Mexico's compliance with her obligations under international law.

Roads and Road Construction Year Book and Directory, 1940–41. 10*s.* 6*d.* Carriers Publishing Company, 68 & 69 Shoe Lane, London, E.C.4.

This, the ninth, edition of *Roads and Road Construction Year Book and Directory* contains more than 400 pages of information useful both to the road engineer and to the technologist who is interested in materials for road construction.

Nearly a third of the book is devoted to a review of Road Development in 1939 and a Survey of Current Practice, including a Bibliography of recent literature on road-making, etc. These sections are followed by comprehensive lists of names of Highway Officials, Manufacturers and Suppliers of Road-making Materials, Road Contractors, and Proprietary Names.

ASLIB War-Time Guides to British Sources of Specialized Information. No. 1. Fuel and Allied Interests (excluding Electricity). June 1940. Association of Special Libraries and Information Bureaux, 31 Museum Street, London, W.C.1. Price 2*s.* to Members of ASLIB, 2*s.* 6*d.* to Non-Members.

This useful guide to British sources of specialized information relating to the Coal, Petroleum, Gas, and Gas-coke Industries is arranged in seven sections. The first section is devoted to a description of the war-time organization of these industries; Section 2 gives a list of sources of specialist information relevant to Fuel and allied interests; Section 3 lists periodicals publishing abstracts or lists of references; Section 4 covers trade and technical periodicals; Section 5 comprises publications issued by professional organizations and industrial concerns; Section 6 lists annual publications. Subject indexes to sources of information and to publications are given in the final section.

British Standard No. 903—1940 Methods of Testing Vulcanized Rubber. Pp. 74. British Standards Institution, 28, Victoria Street, London, S.W.1. Price 5*s.* net.

The British Standard Methods of Testing Vulcanized Rubber—*i.e.*, the product obtained from natural raw rubber by heating it with sulphur and/or some sulphur-containing compounds—have been based on those of the Research Association of British Rubber Manufacturers.

Full details are given of methods of chemical analysis of vulcanized rubber and of methods of physical testing of soft vulcanized rubber and ebonite. The methods of test are precision standards of reference, and it is pointed out that it is not expected that all the refinements of detail will be applied in day-to-day routine test work.

Directory of British Fine Chemicals. Produced by Members of the Association of British Chemical Manufacturers, 166 Piccadilly, W.1. Pp. 79. April, 1940. (*Distributed gratis to bona fide users of fine chemicals on direct application to the above address.*)

This publication, comprising a list of fine chemicals manufactured in Great Britain together with an index to manufacturers, supersedes the edition published in April 1935.

The Motor Transport Yearbook and Directory. 24th Annual Volume. 1939–40. Pp. 786. Electrical Press, Ltd., 60, Kingsway, London, W.C.2. Price 30*s.*

The classification of the contents of this volume follows that of previous editions, and consists of a Statistical Survey and four main sections. "Road Transport Organization" is the title of a section dealing with law and other data relating to licensing, taxation, construction, equipment, maintenance, and use on roads of motor vehicles for public passenger and goods transport. Section I is devoted to a comprehensive survey—financial, commercial and descriptive—of motor transport undertakings. Section II provides financial and commercial information of the manufacturing companies which produce the vehicles and accessories required for the transport services. Section III comprises the names and addresses of the directors and officials engaged in the undertakings described in the *Year Book*.

Statutory Rules and Orders, 1940. No. 749. Emergency Powers (Defence). Petroleum Department. Pp. 2. H.M.S.O., York House, Kingsway, London, W.C.2. Price 1*d.*

Relates to the establishment of a Petroleum Department of the Board of Trade under a Secretary for Petroleum.

Statutory Rules and Orders, 1940. No. 826. Emergency Powers (Defence). **Motor Fuel Rationing.** Pp. 5. H.M.S.O., York House, Kingsway, London, W.C.2. Price 2*d.*

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Geology and Development.

1231.* Results to Date of Drilling for Oil in England and Scotland. W. Kauenhowen. *Oel u. Kohle*, 15.3.40, **36** (11), 99–109.—Prospecting licences issued between December 1935 and September 1939 closely cover the various oil provinces, amount to about one-eighth of the total area of the country, and are divided among four companies: D'Arcy Exploration Co. (64%), Anglo-American Oil Co. (21%), Gulf Oil Co. (Great Britain) (13%), and Steel Bros. (2%).

From the geological point of view, three oil provinces can be distinguished: the Carboniferous, the Zechstein, and the Mesozoic (Jurassic and Wealden).

The oil shows and the results of drilling in the South of England Mesozoic area are described. The explanation for the failure of the borings in this area may be sought in the palæogeographical and tectonic conditions. These are discussed, and it is concluded that this failure is due to the lack of suitable reservoir rocks, the lack of "salt tectonics," and the small subsidence of the basin of sedimentation as compared with conditions in North-west Germany.

The Zechstein oil province is limited to the extreme east of England and is small in extent. Its development is very similar to the German Zechstein, but the oil shows are unimportant, and are confined in the main to bituminous odours in the mid Zechstein and to rare traces of liquid oil. Anticlines in the Yorkshire Jurassic are being tested for the Thuringian types of deposit.

Oil shows are more frequent and important in the British Carboniferous. These are described, as are also the results of the earlier drilling in the Midlands. After the failure of the Gun Hill and Edale wells, drilled during the present period, attention was turned to buried Carboniferous structures such as the Derby and Notts. coal-fields. A subsidiary anticline on the easterly plunge of this basin, in the neighbourhood of Eakring, was drilled and gave an initial production of 17 tons/day from a 45-ft. sandstone in the Lower Coal Measures. On the west side of the Pennines, where the Lancashire Coal Basin plunges westwards under a Permo-Triassic cover, seven out of eleven wells at Formby found Keuper Marl impregnated with light oil at depths of 100–120 ft. 70 tons of oil were obtained from three wells in 1½ months. This is undoubtedly a secondary deposit, and demands closer attention, which, because of the complicated conditions due to faulting and glaciation, will involve more drilling and geophysical work.

Conditions are different in Scotland, where oil-impregnated sandstones are interbedded in the oil-shale series. It seems probable that the greater part of the Scotch oil is not normal crude, but is derived from contact metamorphism of the shales. The most important structure there is the d'Arcy-Cousland anticline. A small oil production is obtained, but the hope of finding lower sands has not materialized. Prospecting north of the Forth led to the discovery of an anticlinal structure at Kirkaldy, but deep drilling on this had not commenced at the outbreak of war.

S. E. C.

1232.* Greek Exploration. R. G. Drown. *World Petrol.*, Feb. 1940, **11** (2), 23.—The first wildcat drilled by Helis in Greece is near the Ionian sea-coast, on the west side of the Peloponnesian peninsula, 15 ml. from Pyrogos. It is within sight of the island of Zante. In addition to favourable geological structure, there are numerous surface indications of oil and gas.

Oil manifestations in Greece are mainly in Miocene beds. In the test-well oil showings were found more than 4000 ft. deep, and the same area has given a gas yield said to amount to 20,000,000 cu.ft./day.

G. D. H.

1233.* Petroleum Exploration in Brazil. Anon. *World Petrol.*, Feb. 1940, **11** (2), 26.—In the past 20 years sixty-four wells have been drilled in Brazil in search of oil. The most favourable areas for oil are believed to be the Atlantic coast sedimentary belt from the State of Rio Grande do Norte to the State of Rio de Janeiro, Western Acre near the frontier of Peru, and the Permo-Triassic belt of Southern Brazil. On the Atlantic coast are folded and faulted Cretaceous and Tertiary beds, with traces of oil in the Cretaceous. In 1939 a well penetrated a Cretaceous oil horizon at 702 ft.

The centre of the Acre region is mainly Tertiary, and there are also beds corresponding to the petroliferous horizon at Aguas Calientes in Peru.

In the Bahia Reconcavo are Cretaceous sandstones and bituminous shales.

G. D. H.

1234.* Nebraska Joins the Oil States. J. A. Kornfeld. *World Petrol.*, Jan. 1940, **11** (1), 33.—Commercial oil production was first obtained in Nebraska in November 1939, when a wildcat in the south-east found oil in a Silurian limestone. The discovery can be attributed to the reflection seismograph. This well topped the Mississippian limestone at 2029 ft. and Silurian limestone at 2288 ft. In the first day's pumping 130 brl. of oil were produced.

Glacial deposits are at the surface in this area, resting on Permian and Pennsylvanian. Immediately under the Mississippian are Silurian dolomites. The greatest thickness of Silurian recorded is 459 ft. Ordovician and Cambro-Ordovician are known to be present, and wells have penetrated pre-Cambrian schist. The nearest Silurian outcrop is 235 ml. due east, whilst the nearest Silurian production is 170 ml. to the south-west in Kansas, where accumulation is the result of pinching out of the Hunton on the flank of the Graber structure. 250 ml. to the east is the old Colmar field of Illinois.

The local structure of the Falls City field is a secondary fold to the east of the Table Rock anticline, itself the northern extension of the Nemaha Granite Ridge. The structure may be faulted.

G. D. H.

1235.* Geology and Economic Significance of Mississippi Oil Development. J. A. Kornfeld. *World Petrol.*, March 1940, **11** (3), 38.—The Tinsley field is in the west central part of the State. It has eleven wells proving an area of 1200 acres, and its daily production is 2100 brl. Its discovery led to great exploratory activity in Mississippi. Semi-commercial production was found at Jackson in 1930 in the Selma Chalk. In 1932 dead oil was discovered in the Eutaw, near Quitman.

Tinsley, opened in 1939, yields oil from the Woodruff sand of the Selma Chalk at over 4500 ft. There is a southerly plunging anticline, apparently a truncated structure of igneous origin, with no free gas, and a sand of variable thickness. The structure was first indicated geologically and then checked geophysically.

In January there were sixty-five geophysical parties at work in Mississippi—thirty seismic, thirty gravity, and four magnetic (in igneous province of Western Mississippi).

Various wells have reached igneous rocks in Western Mississippi. Some of these are post-early Cretaceous. At Jackson there are igneous rocks.

The Jackson gas-field covers 7500 acres. It was discovered in 1930 at a depth of 2430 ft. in the Gulf Cretaceous. Some 84,816,231,000 cu. ft. of gas have been recovered. Some of the wells had an oil spray.

Unsuccessful attempts have been made to obtain oil and gas production on the broad, gentle Hatchetigbee anticline. In North-east Mississippi, on the south-west end of the Cincinnatti arch, the Mississippian gives gas at Amory (Hartselle and Bethel sands). Tests should be made in the Ordovician of North-east Mississippi.

G. D. H.

1236.* World Crude Production up 5·59%. Anon. *World Petrol.*, Feb, 1940, **11** (2), 41.—World production at 2,076,852,000 brl. for 1939 was 110,265,000 brl. above the 1938 figure. U.S.A. production increased by 4·3% and that of the rest of the world by 7·6%. U.S.A. still provides more than 60% of the total oil output. Consumption seems to be increasing more rapidly outside U.S.A. than within.

Illinois had a spectacular rise to fifth place amongst the U.S.A. states.

Russia is still second on the world list of producing countries, and Venezuela third. There was a decline of 4·9% in the Rumanian production, whilst the total German output rose by 21·5%. Saudi Arabia, Canada, Egypt, and Albania had marked increases in oil production.

G. D. H.

1237.* Production of Oil in Western Asia. Anon. *Rev. Pétrolif.*, 24.4.40 (883), 236.—The region between the Caucasus and the Indian Ocean yields 46,264,000 tonnes of oil/year. In 1939 Iran gave 10,367,000 tonnes, and is capable of tripling its output. Arabia's production was 525,000 tonnes and Bahrein's more than 1,000,000 tonnes.

Since 1936 Iraq has averaged more than 4,000,000 tonnes/year. Egypt gave 636,000 tonnes in 1939 and the Caucasus 29,562,000 tonnes. The aggregate is 15·6% of the world's output. G. D. H.

1238.* New Stage in the Search for Oil by the A.G.I.P.—1940–1945. C. Migliorini. *Rev. Pétrolif.*, 27.4.40 (884), 255.—The first stage of the search for oil in Italy ended in 1933, and although the results were unimportant commercially, the data obtained were of value in directing further work. It was shown that oil possibilities existed in the Padana valley, and that there were hydrocarbons throughout the Apennines, and especially on the Adriatic side. In the second stage the adoption of rotary drilling presented some difficulties. The geological problems were still far from completely solved, but this period was marked by the definition of gas-bearing beds at Podezano and Bellena, and a small oil and gas horizon at Tramutola Potenza. Certain geological generalizations became clear, and the problems of the new stage of investigation are now well defined. G. D. H.

1239.* Oil Struck at Saint-Marcet. G. Dichter. *Rev. Pétrolif.*, 4.5.40 (885), 267.—The Pinat well on the Saint-Marcet anticline, which found a large volume of gas in July 1939 at 1520 m., has now struck oil. Several oil-bearing beds were met, and that which is producing lies 1800–2000 m. deep. Several tonnes per hour have been produced under a pressure of 95 kg./cm.^{2}. The oil yields 22% of gasoline, a lubricating oil comparable to Pennsylvanian bright stock, and 4% of paraffin. G. D. H.

1240.* Oil in France. Anon. *Rev. Pétrolif.*, 4.5.40 (885), 268.—Most of the Languedoc oil indications lie near the south-east margin of the Montagne-Noire. Near Gabian is an oil seep accompanied by carbon dioxide and hydrogen sulphide. During the latter part of the nineteenth century wells and shafts were put down in this area, and in 1924 a well on an anticline gave an oil flow from the Trias at a depth of 106 m. Some fifty-seven wells were sunk, of which fourteen were producers. The maximum production was 6000 tonnes during 1926. Gabian appears to be the remnant of a petroliferous area which was largely destroyed by earth movements and igneous activity.

In 1938 a well at Pic Saint-Loup was in hard Domerian limestone at 383 m., and lay between two lines of seeps. A well drilled on Saint-Marcet anticline after geophysical work found oil impregnation at 800 m. It was stopped in black Posydonomia marls below dolomites.

At Gorniés a well went to 456 m. and found oil shows, but it was affected by strong water-flows.

A second well on the Saint-Marcet anticline found gas at 1520–1530 m., which seemed wet. It was estimated to give 200,000 cu. m. of gas/day. This area has many oil shows on Cretaceous anticlines and near Trias faults. G. D. H.

1241.* Drilling in First Six Months almost at 1937 Level. L. J. Logan. *Oil Wkly*, 8.7.40, **98** (5), 12.—Completions in the first half of 1940 were almost at the 1937 level, and were 19·4% above those of the same period of 1939. 14,911 wells were completed. A table gives the details of the completions for the first six months—number of oil, gas and dry wells, and initial production of these wells by States.

Decreased drilling as compared with 1939 is the case in Arkansas, Colorado, Kentucky, Michigan, East Texas, the Corpus Christi, and San Antonio areas of South-west Texas, and the Texas Gulf Coast. Completions in California, Pennsylvania, New York, and Illinois were respectively 27%, 69%, 118%, and 5% above the 1939 figures. G. D. H.

1242.* Tennessee's Oil and Gas Prospects. J. H. Overstreet and H. G. Maxey. *Oil Wkly*, 8.7.40, **98** (5), 35.—Oil was first produced in Tennessee 120 years ago, but few attempts have been made to develop areas in this State scientifically. East Tennessee is considered the least favourable part of the State for oil and gas, on account of its geological complexity. Oil and gas have been found in the northern part of the Cumberland Plateau in the Mississippian at shallow depths. The Highland Rim (flanks of the Nashville dome) yields oil from Mississippian–Lower Ordovician rocks at

shallow depths. There are minor flexures, and a number of fields have been developed. On the whole the wells are not large. Generally in the Highland Rim region wells located on closed structures, according to approved methods, prove profitable.

The problems associated with drilling wells in the above regions are described.

The Central Basin has mainly dense Lower and Middle Ordovician limestones at the surface, and no oil or gas has been found there. A sandy dolomitic horizon 1200–1500 ft. below the Chattanooga has a few oil and gas shows. In Western Tennessee the Palæozoic rocks dip west very gently beneath Upper Cretaceous and Tertiary sands and gravels. More than a score of wells have reached the Palæozoic, some having oil and gas shows in the Upper Cretaceous and also in the Palæozoic. Geophysical work has been carried out in Western Tennessee, and two wells were drilled in areas where the nature of the structure was doubtful. One of the wells had oil shows, and geologists believe that better-placed wells will have good prospects.

G. D. H.

1243.* U.S. Continues to Find many New Fields. Z. H. Mischka. *Oil Wkly*, 15.7.40, **98** (6), 15.—During the first half of 1940 about 135 new oil-fields were discovered, and new pay horizons were found at the 1939 rate. Texas has contributed the greatest number of discoveries, there being twenty-four new fields and twenty-eight new pay horizons in the south. Wilcox production was found at 8150 ft., some 150 ml. west of the nearest producer from the same zone in South Texas. In North Texas prolific wells were completed in the Bend horizon at Bonita and Ringgold. The Ellenburger dolomite was found to be productive in the K-M-A field. Four distillate fields were opened on the Texas Gulf coast, and there were eleven oil and two gas strikes in West Texas.

Thirteen oil-fields were opened in Illinois. The principal factor in Illinois production is the Lake Centralia–Salem field. Wildcatting is expected to increase in the northern part of the State. Nine wildcat oil strikes were recorded in Michigan. The Pickens field of Mississippi, a new discovery, now has four wells producing from the Midway at 4800–4900 ft. Ten new fields were opened in Louisiana, and there were two strikes in Arkansas. The main developments in California were the discovery of new deep horizons in proven areas. Oklahoma has twenty new fields, mainly small, and Kansas twelve new fields and ten new horizons in old fields. No new fields were found in the Rocky Mountain district, but there were extensions to old fields in addition to the opening of new producing zones.

The Forest City basin of Kansas, Nebraska, and Missouri has come into the limelight with two producing wells.

G. D. H.

1244.* Centralia Devonian Hits Peak; Decline already Started. H. F. Simons. *Oil Gas J.*, 11.7.40, **39** (9), 28.—In consequence of the completion of prolific Devonian wells at the northern end of the Centralia field, this field is now the third largest producing area in U.S.A. However, the decline seems to have set in already. In the week ending 29th June 119,000 brl./day came from the Devonian lime and about 5000 brl./day from the Benoist. Quite a number of wells come in at more than 10,000 brl./day.

The Devonian production seems to cover about the same area as the Benoist. About half the area is densely drilled, but the northern end has a 20-acre spacing. Nearly all the wells make water—1–80%, with an average of 5%. There is a good water drive, which is not, however, being used to the best advantage. Water encroachment has not yet caused any serious concern.

Wells decline rapidly down to about 100 brl./day—many wells fall to 10% of their initial production in 10 days. They probably give two-thirds of their ultimate production in the first two months.

No new Trenton tests have followed the Trenton discovery at Centralia.

About 10,000–12,000 brl. of oil/day come from the old Illinois fields; 10,550 brl./day from the new Indiana fields, and 13,500 brl./day from Kentucky (mainly from the old fields).

G. D. H.

1245.* Coming Months may be Texas' Most Active. R. M. Sanford. *Oil Gas J.*, 11.7.40, **39** (9), 32.—Wildcatting still continues very actively in the counties bordering

the Fort Worth basin. The Hull–Silk field is proving its importance, having 295 wells producing from five horizons and not yet being fully defined. Ellenburger production has been found at 4400 ft. in K.M.A.

The older fields of North Texas, Johnson to Burkburnett, Petrolia and Nocona, are related to the Red River uplift. Almost all over Archer county are shallow fields associated with stratigraphic conditions at the northern end of the Bend Arch. The Muenster Arch or buried mountain range of the Fort Worth basin gives fields in Cooke County. These fields paved the way to the discovery of deeper fields in traps which were merely depth intensifications of the shallow producing structures.

Since the discovery of five new fields at deeper levels on the north-west rim of the Fort Worth basin, exploration has spread eastwards into Montague county.

The Walnut Bend field has thirty-five deep wells and is still expanding.

G. D. H.

1246.* Hungary. Anon. *Oil Gas J.*, 11.7.40, **39** (9), 39.—Another producing field is reported to have been discovered in Hungary. It lies in the region of Szentes between the Tisza and Maros rivers, and is said to be capable of large production.

The Budafa–Puszta field is Hungary's chief source of oil, having given 2000–4000 brl./day during 1939. G. D. H.

1247.* Carboniferous Tertiary Deposits in the Southern Argentine and Chile. J. R. Guinazu. *Bol. Inform. Petroleras*, March 1940, XVII (187), 16–71.—This is a long and very interesting article written in view of the European War, which threatens to deprive the Argentine of a regular supply of coal. Up to date no coal deposits of any importance have been discovered in the Argentine, but lignite is found in Patagonia. There is also a small lignite deposit at Cushamen. These deposits would only be of service to the Patagonian railways, as the cost of transport to Buenos Aires would be very high. There are, however, further possibilities in Patagonia and in Tierra del Fuego which should be explored at all costs. It is suggested that a Commission be appointed to study the whole question, in respect to which Sr. Guinazu's paper provides a valuable contribution. H. I. L.

1248. Recent Progress in Petroleum Development and Production. H. C. Miller and G. B. Shea. U.S. Bur. Mines Reprint, 1940.—This report was first presented before a sub-committee formed to promote the conservation of petroleum in the United States; to provide for co-operation with the States in preventing the waste of petroleum; to create an office of petroleum conservation; and for other purposes. It reflects progress made in petroleum production during the five years 1934–1938 inclusive. The significant conclusion is reached that the overwhelming trend in the industry is towards the application of science and engineering to problems of exploration, drilling, and producing. During the five years under review 752 new oil-pools were discovered in the U.S.A., of which it is estimated 489 will ultimately produce more than 1,000,000 brls. of oil. Advances in exploration technique are evident from the fact that the number of major oil-fields found by scientific knowledge far exceeds those discovered by wildcat drilling. Many new pools are also being discovered in areas that former exploratory methods failed to distinguish as oil-bearing.

Wells are being drilled increasingly deeper, and because of improvements in equipment and technique it is now possible to reach depths of nearly 3 miles in the same time as it was possible to drill only some 5000 ft. a few years ago.

The production branch of the industry has benefited by the results of a vast amount of research carried out in oil-company, private, and Government laboratories. This research has concerned particularly reservoir pressures and temperatures; examination of subsurface samples of oil; the work that a given volume of reservoir fluid can perform when expanded from reservoir pressure and temperature to atmospheric conditions; the problem of fluid flow through reservoir sands; the "connate" water content of oil-sands; and physical examinations of core specimens of the formations penetrated by the wells.

There is now a marked tendency in the industry towards more economic spacing of wells and an increased general recognition of the fallacy of drilling more wells in one pool than is absolutely necessary from the point of view of oil recovery.

Proration was in the first place designed to check over-production of crude oil, but it has gradually developed into a conservation measure. By proration the production of wells is curtailed and new wells are not permitted to flow " wide open," with consequent wastage of gas and reservoir energy. It has been found that pools are most efficiently operated by utilizing to the full the energy in the reservoir. If this energy is properly conserved, the natural flowing life of wells is prolonged and the need for installing pumping equipment is postponed until practically all recoverable oil has been withdrawn from the pool.

Great advantages accrue from unitization of oil-pools, and it is surprising that the practice of operating a pool as though a single owner controlled the oil and gas rights is not more universal. The chief handicap to unitization is the barrier to participation caused by " hold-out " operators, landowners, and royalty interests who for various reasons will not join in the plan. A better understanding of the advantages of unitization by both large and small operators would no doubt lead to more widespread adoption of unit operation plans. H. B. M.

Geophysics.

1249.* Reflection and Transmission Coefficients for Plane Waves in Elastic Media. M. Muskat and M. W. Meres. *Geophys.*, 1940, **5** (2), 115–148.—There have been no complete and systematic calculations of the reflection and transmission coefficients for plane waves incident on elastic interfaces, although the equations were derived 40 years ago. Systematic tables for those coefficients for various types of interfaces should make it possible to predict the intensity of various waves created at a single interface and also, by following each of these waves, the resultant effect of a stratum as a whole. Six sets of tables are therefore given, covering the amplitudes of reflected and transmitted longitudinal and transverse waves, their intensities, and the fractions of the incident energy carried away by them. A final table gives the reflection coefficients for the incidence upon an elastic interface of transverse waves polarized normal to the plane of incidence. Most of the results are limited to angles of incidence not exceeding 30°, but as this range is of greatest interest in reflection shooting, they should cover most of the situations occurring in practice. S. E. C.

1250.* Seismic Wave Energy Reflected from Various Types of Stratified Horizons. M. Muskat and M. W. Meres. *Geophys.*, 1940, **5** (2), 149–155.—The amplitudes and intensities of waves recorded at the surface cannot be used as a basis of interpretation, since they are the resultants of multitudes of extraneous effects superimposed on the direct reflection and refraction processes occurring at the horizons being studied. At the same time, a knowledge of the reflection and refraction coefficients can provide qualitative considerations regarding the possibility of getting satisfactory records under given conditions. Twelve examples to illustrate this are worked out, using the reflection and transmission coefficients tabulated in a previous paper (see Abs. **1249**). S. E. C.

1251.* Computation and Mapping of Seismic Reflection Data. M. B. Widess and N. A. Haskell. *Geophys.*, 1940, **5** (2), 156–168.—Computations based on curved paths in order to overcome the errors involved in the assumption of a straight ray path may be subject themselves to even greater errors by the assumption that velocity is a function only of depth. This is especially the case with steeply dipping strata. As, however, such a velocity relationship is frequently assumed and in certain cases is true, a dip equation based on this rule is presented. In this equation it is assumed that the reflecting horizon is plane; the effect of curvature of the surface is therefore discussed. Further, it is assumed that the seismometer spread is orientated along the direction of maximum dip of the reflecting horizon, a direction which is generally unknown. The dip has therefore to be determined from data obtained by spreads oblique to the dip direction. This may be done by calculating the dip for each spread and assuming this to be the component of true dip in that direction. A more rigorous treatment, based on time-maps, is also given. S. E. C.

1252.* Change of Reflection Amplitude and Character with Geophone Depth. H. M. Houghton. *Geophys.*, 1940, **5** (2), 169–175.—Experiments were made at four loca-

tions in Oklahoma to determine whether the depth at which a geophone is placed beneath the surface has an appreciable effect on the character and amplitude of the recorded reflections. The records obtained from geophones placed at depths varying from 10 to 240 ft. were compared with the record given by a geophone at 2 ft. The amplitude–depth relationships had a common characteristic in a rapid decrease in reflection amplitude with a moderate increase in depth. This is undoubtedly due to an increase in acoustic impedance with depth. Efforts to correlate amplitude and character of reflections with the type of material in which the geophone was placed were unsuccessful. This was also the case with an attempt to equate the motion of the geophone at depth with movement caused by waves arriving from below plus the reflection of those waves from the surface. The ratio of reflection amplitude to ground unrest remained nearly constant while the geophone was lowered, thus indicating a tendency for no great change in the signal–noise ratio if the geophone is placed in deep holes. S. E. C.

1253.* Relative Gravity Measurements Using Precision Pendulum Equipment. M. W. Gay. *Geophys.*, 1940, **5** (2), 176–191.—Special pendulums, ground from single pieces of fused quartz, were made in order to establish stations for the calibration of gravimeters. Details of the design of the pendulums, two of which are mounted in the same support and swing 180° apart in phase, are given and data tabulated in order to illustrate the precision of the measurements. S. E. C.

1254.* Recent Progress in Geophysical, Geochemical, and Electrical Prospecting Methods for Petroleum. J. B. Eby. *Petrol. Engr*, Midyear 1940, **11** (10), 122.—In general, the magnetometer, gravity-meter, electrical prospecting, and soil analysis are now regarded as valuable reconnaissance methods. The torsion balance is a reconnaissance and detail instrument. The refraction seismograph has been used for reconnaissance and detail, but its operation is expensive, and it is much inferior to the reflection seismograph for detail work.

The main mechanical developments have been towards an increase in portability.

The U.S.A. geophysical activity is at about last year's level.

Geochemistry is being widely applied, especially in California, the Gulf Coast, and Kansas. Geochemical well-logging is receiving increased attention and achieving more success. Geochemistry has not yet been able to establish criteria to differentiate between commercial and non-commercial accumulations of oil and gas; its results are qualitative rather than quantitative.

Cuttings can be tested geochemically, and this should be done within 48 hr. They are tested for methane, butane, pentane, and higher hydrocarbons. Examples are given of geochemical well-logging, a process which does not, however, replace electrical logging or core analysis. The data are related to the presence or absence of hydrocarbons, for their influence seems to extend short distances laterally and vertically beyond the limits of production—*i.e.*, the effective depth of the well is increased by several hundred feet, and its effective diameter by anything up to a quarter of a mile.

Electrical transients are now capable of deep penetration, and have been used where seismic reflections are difficult to obtain. G. D. H.

Drilling.

1255.* Directional Drilling, Surveying, and Polar Core Orientation. G. L. Kothny. *Oil Gas J.*, 4.7.40, **39** (8), 40.—The reasons why oil-wells should be drilled as nearly vertical as possible are detailed, and a discussion is given, showing why, if certain conditions exist, directional drilling is attempted purposely to deviate the hole from the vertical. Both cases, however, are similar, in that they require frequent and accurate surveys of the bore-hole.

Instruments used in surveying wells are described, those of the photographic recording types in some detail. The interpretation of survey records is then given. To know the location of any point of the course of a hole it is necessary to know

its true vertical depth, its latitude, and the extent of its departure from a datum point. The method of calculating these quantities is briefly given.

Directional drilling using whipstocks is next discussed, and magnetic orientation of deflecting tools is detailed.

Finally, the paper describes polar core orientation. By this method the direction of the dip of the core sample is obtained from the magnetic properties the sample acquired from the earth magnetic field. The instrument which is described for determining the orientation operates automatically, is self-checking, and operates electrically. It is assembled on a large oak table with the magnetic system on one end and the recording system on the other. The core is held in a core-holder, and rotates in a horizontal position below an astatic magnetic system one full revolution in about 30 min. Photographic records are taken by means of a mirror and spot-light for two revolutions, the second being in reverse direction of the first. The instrument, records, and the method used in interpreting the charts are illustrated.

A. H. N.

1256.* New Portable Rig Uses Torque Converter and 90-ft. Folding Mast. T. P. Sanders. *Oil Gas J.*, 11.7.40, **39** (9), 53.—A tyre-mounted drilling rig is described, designed for 6000-ft. drilling, and using a hydraulic torque converter to combine steam-engine power characteristics with the portability and fuel economy of the internal-combustion engine.

Although the rig is mounted on a base small enough to travel on the highways, it incorporates a 90-ft. derrick, which is raised and lowered completely intact by means of hydraulic cylinders. The derrick has a capacity of 200 tons, and the upper 60 ft. of it can be removed and carried individually if required.

Other unusual features include hydraulic breakout lines and a rotary head which grips the kelly over a 48-in. length to minimize whipping of the drill stem. A. H. N.

1257.* Oil-field Development and Drilling Methods. K. C. Slater. *Petrol. Engr*, Midyear, 1940, **11** (10), 13–16.—In this review of methods and principles employed in oil-field development the importance of well-spacing programmes is emphasized, but it is pointed out that well spacing is still largely decided by arbitrary assumptions based on past experience. References are given to literature dealing with this as well as problems of appraising reservoir conditions, proration, etc.

Deep-drilling activities are reviewed. Efforts are being made to obtain greater economies in drilling, and these have resulted in studies of rate-of-penetration. It was revealed that one-third of drilling time was spent on running in and out of the hole, which fact emphasized the importance of bit service. Improvements in bits has resulted in a reduction of the running in and pulling out time to one-fifth the total drilling time. Drilling speed has increased from 5 ft. to 50 ft./hr. and bit footage from 75 ft. to 1000 ft.

The Carter core-barrel is briefly described and pressure coring is reviewed generally. This process is still being perfected. Electrical coring has been improved by the addition of several new devices, particularly those dealing with testing the mud stream continuously for oil and gas and salt water. A somewhat recent system is logging a well whilst drilling by utilizing the drilling-string and bit as electrode.

An innovation in well-cementing is mixing radioactive materials in the cement, which process makes it possible to estimate the position of the cement behind the casing. Methods of reducing channelling include mixing bentonite with the cement and using certain mechanical centralizing means for the casing.

In well-completion practices, gravel packing is now advocated as a proper method of completing wells in unconsolidated sands. Multiple-sand completion practices are reviewed, together with the use of drillable liners for such purposes. A. H. N.

1258.* Advancement in Drilling Technique in California. W. A. Sawdon. *Petrol. Engr*, Midyear, 1940, **11** (10), 108.—There was no new depth record in California last year, but 10,000 ft. deep wells have become more common than was previously the case. Speed in drilling has increased, and the record is believed to have been broken.

Rotating speeds as high as 750 r.p.m. have been tried, but only one company used speeds exceeding 500 r.p.m. Remarkably fast, straight holes have been drilled with

high rotating speeds, but intelligent co-ordination of equipment and technique was found essential.

In surface equipment, two new draw-works of a size larger than any previously used have been put in service during the last six months. These are described. The contemplated use of 1½-in. lines has not materialized, and it appears that 1¼-in. will still be the most generally used in deep fields. Latest types of blocks are constructed with drums instead of shafts, which fact makes the sheaves virtually rims with large-diameter roller bearings. Descriptions of other items are given for surface equipment, including derricks, rotaries, boilers, etc.

As high pressures and large volumes of circulating fluid have become necessary in deep-drilling operations, there has been a tendency to use as large a diameter drill pipe as is practicable. A $5\frac{9}{16}$-in. drill pipe is frequently employed to depths ranging from 8000 to 10,000 ft. The use of long drill collars to give weight just above the bit, and thus keep all the drill pipe in tension, has been an important factor in keeping holes straight.

Mud fluids used have not been excessively heavy. Probably the greatest weight being carried is 100 lb./cu. ft.; however, the average is only 78–85 lb./cu. ft., and weights above 90 lb. are uncommon. Weighting material is employed. Chemical treatment is most widely applied for deflocculation and reduction of viscosity. Two of the complex phosphates are used, tetrasodium pyrophosphate and sodium tetraphosphate.

Two new degassers have been put into service, and these are described. A. H. N.

1259.* Drilling Time Studies. H. L. Flood. *Petrol. Engr*, July 1940, **11** (11), 23–24.—Drilling-time studies involve no complications either in apparatus or drilling practice. They impose on the driller the routine job of recording the time required to drill a given number of feet of hole. The usual procedure is to note the time required to drill 2 ft., 5 ft., or 10 ft. of hole. Readings taken at these intervals generally result in a drilling log of sufficient accuracy to disclose information concerning the formations drilled, and serve as a reliable check on cores taken periodically or on the results of electrical logs.

Charts are reproduced correlating drilling-time curves with electric logs for a well, and variations in drilling time are supported by evidence from the electric log to show that a pay sand has been penetrated. A. H. N.

1260.* Use of Bulk Cement in Wells. Anon. *Petrol. Engr*, July 1940, **11** (11), 74.—The use of large-capacity cement hoppers is advocated as reducing time required to mix and place slurry in deep wells. A. H. N.

1261.* Drilling Footage near Peak as Wells go Deeper. Anon. *Oil Wkly*, 15.7.40, **98** (6), 19–20.—Statistical data are presented for drilling activity and depths reached this year. Average drilling depths show an increase as compared with last year. The total footage is increased by greater average depths and also by an increase in the number of wells drilled. A. H. N.

1262.* Depth Measurement by Means of Multiple-Strand Wire Lines. H. E. Gross and J. P. Hays. *Oil Wkly*, 22.7.40, **98** (7), 13–17. *Paper presented before American Petroleum Institute.*—The tolerance between the various methods of depth measurement should be 1 ft. in the first 4000 ft., and should not increase more than 1 ft./additional mile depth. Greater discrepancies show poor workmanship.

The cable is always under full tension of its own weight, as it is lowered, and therefore no correction for stretch need be applied when stringing in. As a pipe is usually measured as it stands on the rack, this fact does not apply to the case of depth measurement with a pipe. Elongation correction due to temperature is customarily ignored in depth measurement.

Standard rigs, cable-tool drilling machines, and spudders employ two multiple-strand wire lines for drilling a well. In depth measurements it is both time-consuming and impracticable to measure the entire length of the wire line. The appropriate procedure is to measure very carefully the distance over the derrick between "fixed points" at

the wire-line spool and at the well-head. This distance is the "yardstick" for subsequent measurements. The measurement over the derrick is best obtained in calm weather, preferably about sunrise.

The authors describe in detail and illustrate by diagrams the details of taping over and of measuring with sand-line, drilling-line, spudder, and with portable drilling machines. Accuracy is stressed in all operations.

In cases of rotary drilling units the coring line is used in a similar manner to the sand line. Finally the special methods peculiar to electrical logging, gun-perforating, and well-shooting operations respectively are discussed. In these cases errors inherent in counting mechanisms resulting from inertia slippage and incorrect diameter of the sheaves and lines require adjustments to the positive and precise measurements that should be obtained with the drill pipe or cable. A. H. N.

1263.* Factors Influencing the Bond between Oil-well Cement and the Formation. P. H. Jones and D. Berdine. *Petrol. World*, June 1940, **37** (6), 26. *Paper presented before American Petroleum Institute.*—Cement channelling and factors influencing the bond between set cement and formation were investigated in a series of forty-two tests using relatively large-scale apparatus simulating conditions prevailing during the cementing of oil-wells. The extensive paper is well illustrated photographically.

It is concluded that channelling and chimney formation of cement in the annulus are unlikely in the immediate region of the shoe, but may occur near the top of the cement column.

Wherever cement slurry is applied opposite formations having appreciable permeability, a residual mud cake will remain between the set cement and the formations unless specific means are employed to effect its removal. The presence of collars, movement of casing, or circulation of water may slightly reduce the thickness of the mud cake, but will not remove it completely.

Where casing rests against the walls of the hole, residual cakes will be thicker than normal. There is a tendency for the cement slurry to be excluded from such regions of proximity, thus leaving longitudinal stringers of mud cake with no cement between the casing and the formations.

Three methods were found effective in removing mud cakes: (1) Hydraulic action by direct impingement of fluid jets (such as that induced by down-whirler shoes) against the walls of the hole. (2) Mechanical scraping by using suitable mechanical devices on the casing. This is effective only over areas where scrapers or scratchers make a bearing on the wall of the hole. (3) Acid treatment gave best results under atmospheric pressure conditions. Laboratory tests at high pressure indicate but do not prove that effective mud-cake removal under these conditions may be obtained. A. H. N.

1264.* Rotary Drilling Mud Testing and Control. J. A. McDonough and C. F. Bonnet. *Petrol. World*, July 1940, **37** (7), 36.—The paper describes the important properties of mud; methods for testing are given, and practices are outlined for maintaining muds in condition for fast and safe rotary drilling. The properties studied are weight of mud, water loss and cake thickness, sand content of mud, gel strength, pH value, and salt content, and finally viscosity and chemical treatment of muds. In each case a very brief outline of the significance of each property is given, followed by typical characteristics of a well-conditioned mud and a brief description of the methods or apparatus used in assessing the characteristic quantitatively.

The paper is descriptive and generalized in treatment. A. H. N.

1265.* Technical Trends. Anon. *Petrol. World*, July 1940, **37** (7), 48.—The effects of water from the drilling mud on the formation drilled are discussed and an oil-base drilling fluid is described. This fluid is made up of 55% 38° stove oil, 30% ground calcium carbonate (95% through 200 mesh), 5% lamp-black, and 10% air-blown asphalt. The reason for incorporating lamp-black is to keep the calcium carbonate in suspension for weighting the fluid and for using asphalt is to build a thin cake on the walls. Those wells drilled with oil-base fluids in the hole showed a better productivity index than those drilled with normal clay fluids.

A new pipe-thread lubricant is described. It consists of 50% aluminium soap grease and 50% graphite. The characteristics and specifications of the lubricant are given.

A new cementing procedure adopted recently showed good results. The slurry consisted of 50% cement and 50% calcium carbonate. After setting the cement the casing was perforated in five different zones with inhibited acid stratified against the perforation zones. The acid followed the bullets into the cement, thus dissolving the shattered particles and enlarging the drainage areas. This cementing procedure was used in the completion programme of a well. A. H. N.

1266.* Effects of Acid on Mud Cakes. Anon. *Petrol. World*, July 1940, **37** (7), 51.—In tests performed to show the effect of hydrochloric acid on mud under high pressures a small piece of mud was separated from the acid by a cellophane diaphragm, both mud and acid being in a pressure chamber fitted with a glass window and the necessary instruments to maintain and measure the pressure and temperature obtaining in the cell. The diaphragm was ruptured and the effects of the acid were visually observed and recorded photographically. Five types of mud were tested.

The conclusions reached are: (1) Acidizing mud cakes breaks down the colloidal character of the cakes and gives them a granular structure. (2) The addition of an acid soluble constituent—*i.e.*, calcium carbonate—to the mud hastens the flocculation of the cake with acid, probably because the acid penetrates more easily as the soluble constituent is removed. (3) Calcium carbonate will dissolve in 15% hydrochloric acid under 1000 lb./sq. in. pressure. The carbon dioxide evolved in the reaction is completely dissolved in the water present. A. H. N.

1267.* Conditioning Drilling Mud. F. C. Bowman. *Petroleum World*, July 1940, **37** (7), 53–54.—Six requirements are considered of fundamental importance in drilling muds, and the effects of adding sodium pyrophosphate to the mud on the properties of mud connected with these requirements are studied. These requirements are, in brief: (1) The fluid must lubricate the drill bit. (2) It must hold the cuttings in suspension until it reaches the surface. (3) It must allow the cuttings to settle outside. (4) It must be heavy enough to prevent blow-outs of gas under pressure. (5) It must provide a seal for the formations. (6) Its viscosity should be sufficiently low to make easy pumping and settling out.

The addition of pyrophosphate of sodium helps in all these requirements, except item (4), where the weight of the fluid is not affected to any appreciable extent. The quantity of sodium pyrophosphate used is popularly set at 1 lb./ft. drilled. In a 10,000-ft. well large quantities are evidently used. A. H. N.

1268.* Looking to the 20,000-ft. Well. E. K. Parks. *World Petrol.*, July 1940, **11** (7), 46–53.—The paper constitutes an inquiry into the physical and economical limits of depths to be reached in oil-well drilling. In studying the obstacles to reaching a 20,000-ft. depth, the drilling experience obtained in drilling to 15,000 ft. is analysed. The limitations appear to be: (1) The hole must be straight. (2) The mud must be constantly controlled in physical character. (3) The wire rope used in hoisting drill pipe from 15,000 ft. is excessively loaded. (4) The 3½-in. drill pipe at 15,000 ft. is loaded to the limit of its tensile strength under normal conditions, allowing no margin for extra pull in case of emergencies. (5) Casing for the well sets limitations in the clearances necessary between casing and other items in the well. Each item is discussed separately.

In the engineering section the high temperatures encountered with depths will create difficult problems. The effects of high temperatures and pressures will be particularly severe in mud conditioning, in considerations of corrosion of metals, and in cementing.

In production practice, as soon as natural flow ceases, the process becomes expensive, especially if complicated by emulsions, sand, water, wax, etc.

A study is made of well spacing, cost of drilling, and economics of such a project. Finally, it is concluded that: (1) A well 20,000 ft. deep appears not only as a possibility but as an approaching reality. (2) The chances for profit under present conditions are so narrowed that the 20,000-ft. well may be expected only as a result of some extended prospect. (3) There is no technological reason why such a well should not produce oil and gas at a commercial rate. (4) Development of a 20,000-ft. oil reservoir will require great geological skill and constant expert engineering supervision, in order

to reduce the elements of chance. (5) The high yields required for a pay-out will greatly restrict the number of wells to be drilled into a unit reservoir. (6) The high yields required will tend towards an extension of the pay-out period. (7) The great cost will require minimum royalties and a reasonable assessed valuation on the discovery holdings in order to avoid confiscatory taxes. (8) The cost will discourage competition and encourage unit operation of the deep-well field. A. H. N.

1269.* Drilling Conditions in Turner Valley. V. Taylor. *World Petrol.*, July 1940, **11** (7), 68–71.—Averaging but 41 ft./day and sometimes getting as little as 2 ft. per bit, nevertheless an active drilling campaign continues in Canada's Turner Valley even in excessively cold weather. Some 96% of Canada's domestic production of oil comes from this field.

Drilling equipment and practice are described. Steam is used on all rigs, as there is an abundant supply of water and gas. Rock bits are used exclusively.

Certain preparations are made for winter drilling operations. The derrick is covered in as much as possible and steam heaters are used extensively in order to prevent freezing of various parts of the equipment. It is essential to blow out all mud-lines and water-lines with steam when not in use, and it is also necessary to hook up rat hole so that circulation can be maintained through the kelly when it is not in use. Considerable expense is thus entailed in rigging up for cold-weather drilling.

A. H. N.

1270.* Deeper Drilling Requires Improved Instrumentation. G. L. Kothny. *World Petrol.*, July 1940, **11** (7), 76–81.—In temperature measurements of deep holes, charts show that the "out-run" survey curve is always higher than the "in-run" curve. This is probably due to the time lag, as the instrument will record the temperature of the air immediately surrounding it within the protective casing, and the temperature of this air is materially lower than that of the well fluid or casing. The maximum temperature recorded in two charts was on the out-run, and at a point 2000 ft. above the bottom of the well in both cases.

Surveys made with multi-shot instruments in which a magnetic compass is used for recording the direction may be subject to erroneous recording, due to magnetic fields and influences from sources other than the earth. A chart is worked out giving the correction to be applied to recordings because of the inclination of drill pipe, tubing, or sinker bars of various lengths and inclinations and possessed of a magnetic pole strength of 300 E.M.U. Further, a table is given for errors due to the inclination of the instrument relative to the axis of the drill pipe or casing. Rubber star-shaped guides help to minimize this source of error.

In directional drilling it is necessary to find the orientation of the deflecting tool. A new and successful magnetic method of orientation is described and a sectional drawing of the instrument is given. This is claimed to have the advantages of speed, cheapness, accuracy and self-checking, and of saving rig time.

Finally, core orientation is fully discussed, the instruments used are illustrated, and a specimen report is presented. Cores which have been stored for several years in the core sample-room, as well as cores shipped from foreign lands more than 10,000 miles distant, have been successfully oriented by this method. The process uses the magnetic-core orientation method. A. H. N.

1271.* Hydraulic Couplings in Field Applications. M. T. Archer. *World Petrol.*, July 1940, **11** (7), 81–85.—The simplest form of hydraulic coupling is the traction type. The nature of the rotary drilling, however, imposes the necessity for speed control over a considerable range both at the table and at the slush-pumps. Such control can best be secured by using the variable-speed couplings, preferably the recently introduced scoop-control type.

In connection with mud pumps, a safety factor is provided by using the coupling. Since the pump stalls, the engine need not stall too, as the coupling will slip 100% without overloading the engine. The coupling will naturally dissipate by convection approximately 7–10% slip without overheating the oil. Allowance for higher slip is made by water cooling.

When hoisting, the instantaneous load is severe and the slip of the coupling may be temporarily great, but the short hoisting cycle is followed immediately by an idling

cycle which permits cooling sufficiently to offset the overloading. Nevertheless, it is deemed advisable to provide cooling by auxiliary means, as the rotary table is connected to the hoisting engine in the majority of cases.

Layout of various typical installations and experience gained in different fields are described. A. H. N.

1272.* Fluid Coupling Applied to Rotary Drilling Equipment. G. V. Davies. *World Petrol.*, July 1940, **11** (7), 86–89.—The introduction of fluid coupling, the Vulcan–Sinclair type at first, into rotary drilling equipment has overcome most of the difficulties inherent in the use of internal-combustion engines. This fact is due to the following essential characteristics: a practically complete connection and disconnection of the drive with a continuously running engine; a perfect cushioning medium, since power is transmitted by virtue of the kinetic energy of the oil circulating in the coupling, thus damping out torsional vibrations from the engine and absorbing shock loads from the driven machinery; a completely smooth take-up simply by accelerating the engine and allowing the load to be picked gradually while running; an ability to transmit power equally well in either direction, thus overcoming the difficulty of reversing; an absence of moving parts subject to wear and consequent replacement, with a remarkable simplicity and low initial cost; and a positive safeguard against stalling of the prime mover by overload while transmitting the overload to the driven shaft.

The working of the coupling is briefly explained and well illustrated. The fluid with which the coupling is filled is driven outwards by the centrifugal force transmitted by an impeller with radial vanes, and as the runner always rotates at a slower speed than the impeller, the difference in centrifugal force causes the fluid to circulate around an annular core, and thus act as an energy transmission medium.

The scoop-tube type of coupling is further explained and its advantages are studied. Infinitely variable speed regulation can be obtained over a range of five to one. The speed of a rotary table was reduced from 100 r.p.m. to 6 r.p.m. by reducing the engine speed from 600 r.p.m. to 200 r.p.m. and operating the control. The same results can be obtained in the reverse direction by the use of a double-ended scoop and a reversing engine.

An impulse or momentum start can be applied by closing the scoop-tube control, running the engine up to speed, and then opening the control, and thus a substantial overload torque may be applied for freeing an obstacle. A. H. N.

1273. Arrangements of Filter Tubes in Petroleum Wells. F. R. Ruiz. *Bol. Inform. Petroleras*, March 1940, XVII (187), 72–78.—This article refers in the first instance to the conditions at Comodoro Rivadavia, where the strata consists partly of sands and partly of more friable material. The commonest form of filter tube is a tube with circular perforations. It is pointed out, however, that this type was found to be ineffective. Two types of filter, the MacEvoy and the Kobe, are described, the latter being the type finally adopted. This type of filter is made up by plugging the circular perforations with plugs provided with grooves of a particular shape and section. In order to arrive at a satisfactory design one is dependent on a granulometric analysis which sufficiently nearly anticipates the character of the solids at the bottom of the well. Interesting curves are given in which the percentage retained is plotted against the size of the grains and the size of the opening in the grooves. These curves are taken from the Manantiales Behr. Similar curves are shown for Caleta Cordova in which the conditions are more favourable owing to the fact that the horizon consists of a simple layer of sand. The effect of water is also dealt with very fully. H. I. L.

1274. Drilling Patents. J. B. Graham and R. G. Mayer. U.S.P. 2,206,184 and 2,206,185, 2.7.40. Appl. 21.3.39 and 10.6.39, respectively. Apparatus for guiding and stabbing successive sections of pipe such as oil- and gas-well casings.

T. A. Creighton and T. E. McMahan. U.S.P. 2,206,222, 2.7.40. Appl. 24.7.39. Well-drilling tool, being a bit of special type.

G. E. Cannon. U.S.P. 2,206,389, 2.7.40. Appl. 27.9.39. Method of cementing

wells consisting of allowing fast-setting cement to form a plug at the gas–oil interface, and subsequently cementing with slow-setting cement below the plug.

J. H. Shepler. U.S.P. 2,206,677, 2.7.40. Appl. 8.4.39. Method and means for preparing wells for cementing by pumping a suspension of abrasive material in water to remove mud sheath.

A. Boynton. U.S.P. 2,206,873, 9.7.40. Appl. 28.10.38. Leakless right and left tool joint.

A. L. Smith. U.S.P. 2,206,922, 9.7.40. Appl. 8.8.38. Means and method of detecting the presence of oil in drilling mud by subjecting mud to ultra-violet light and observing the fluorescence caused by oil.

R. D. Haas. U.S.P. 2,207,005, 9.7.40. Appl. 18.10.38. Pipe and tool joint.

L. W. Stahl and R. L. Foster. U.S.P. 2,207,112, 9.7.40. Appl. 25.2.38. Liner construction for slush pumps.

F. W. Hild. U.S.P. 2,207,149, 9.7.40. Appl. 8.10.34. Blow-out preventer.

J. A. Zublin. U.S.P. 2,207,187, 9.7.40. Appl. 15.7.38. Combined fluid and rotary driven drilling bit the cutters of which are rotated by discharge of fluid against them.

J. A. Zublin. U.S.P. 2,207,188, 9.7.40. Appl. 23.1.39. Drill bit.

F. W. Hild. U.S.P. 2,207,199, 9.7.40. Appl. 26.4.37. Blow-out preventer having a hollow packer.

C. A. Lundeen. U.S.P. 2,207,203, 9.7.40. Appl. 14.5.38. Support for upset pipe or rod utilizing slips on an inclined plane.

O. Hammer. U.S.P. 2,207,345, 9.7.40. Appl. 23.3.38. Method and means of cementing wells using a guide-tube at the bottom of the casing.

A. F. Sorben. U.S.P. 2,207,418, 9.7.40. Appl. 5.4.39. Bottom dumping cement bailer.

R. T. Roye. U.S.P. 2,207,469, 9.7.40. Appl. 4.1.39. Casing hanger.

E. Russel. U.S.P. 2,207,478, 9.7.40. Appl. 30.12.36. Apparatus for spraying and casing well with a quick-setting cement or the like.

C. St. J. Bromner and C. M. Potter. U.S.P. 2,207,505, 9.7.40. Appl. 5.4.35. Drill-pipe orienting tool.

J. H. Williams and S. Ackal. U.S.P. 2,207,649, 9.7.40. Appl. 8.9.39. Oil-well fishing-tool.

L. L. Thompson. U.S.P. 2,207,766, 16.7.40. Appl. 7.3.38. Rotary drill bit.

J. D. Hughes. U.S.P. 2,207,920, 16.7.40. Appl. 28.10.37. Expanding foot-piece for whipstocks.

E. E. Anderson. U.S.P. 2,208,011, 16.7.40. Appl. 14.4.39. Inside tubing cutter.

J. D. Eisler. U.S.P. 2,208,147, 16.7.40. Appl. 26.8.38. Photo-electric inclinometer for testing the deviation of a bore hole.

N. Miles. U.S.P. 2,208,194, 16.7.40. Appl. 12.8.39. Safety cage for oil derricks.

J. H. Schreiber. U.S.P. 2,208,197, 16.7.40. Appl. 16.6.37. Joint breaker and cathead.

G. R. Pothe. U.S.P. 2,208,388, 16.7.40. Appl. 11.12.39. Oil-tool spinner for an oil rig rotary table.

L. L. Thompson. U.S.P. 2,208,530, 16.7.40. Appl. 3.2.38. Rotary well drill bit.

D. Scaramucci. U.S.P. 2,208,603 and 2,208,604, 23.7.40. Appl. 17.8.39. Apparatus for cementing wells consisting of a measuring device for determining the position of an object like the top plug in a well. It is a sounding-line, a weight attached to the line and an object adapted to be positioned within the well and arranged to be magnetically engaged with the weight. The second patent incorporates an electromagnet.

H. C. Lawton. U.S.P. 2,208,766, 23.7.40. Appl. 16.1.39. Method of sealing off formations by the controlled formation of a silicic acid gel within the pores, using aqueous solution of a silicate, and a non-metallic salt of a weak base in basic solution. A. H. N.

Production.

1275.* Progress of Gravel-Packing in California. Anon. *Petrol. World*, June 1940, **37** (6), 47.—The paper deals with the history, theory and methods, and the present status and outlook for gravel-packing in California.

Gravel-packing is primarily intended to stop sand production, thus almost entirely eliminating those features which raise production costs. Two photographs show examples of correct and incorrect choice of gravel size, in the former the sand migrating only imperceptibly into the gravel pack, whereas in the latter the entire pack is filled with sand, resulting in drastically reduced flow capacity. Other advantages of gravel-packing include providing a larger open hole with better drainage conditions, the action of the pack as a gas anchor, and the possibility of deeper pump setting and lower fluid level being presented by gravel-packing.

The most commonly used method involves wall-scraping to about 15 in. in diameter, and then circulating the gravel down through the casing and outside the liner through ports in the hanger, using thin mud. A description is also given of the chief types of pre-packed liners available in California. A. H. N.

1276.* Huge Additional Reserves Wait on Improved Production Methods. L. C. Uren. *World Petrol.*, July 1940, **11** (7), 54–57.—The charges of excessive waste of oil both in production practices and above-ground storage usually levelled against producers are shown to be without much basis in many instances. Recent improvements in methods of exploitation of oil-fields are reviewed and the spirit of conservation in production practices is made manifest.

On the other hand, great quantities of oil are still left in the reservoirs because no recovery methods yet discovered are sufficiently economical, with present-day oil prices, to produce more than a part of the oil actually present in the reservoir. It is estimated that between 67,500 million and 110,000 million brls. of oil must have been left in the ground in present known fields. The actual reserve estimated as being recoverable by present methods of production is only 18,000 million brls.

It appears that the main consideration in these problems is an economical one intimately connected with the price of recovered crude and cost of production. A. H. N.

1277.* High Water-cut Samples easily Taken. Anon. *Oil Wkly*, 8.7.40, **98** (5), 22.—Faced with the problem of taking accurate samples on a lease on which a number of wells were going to water quite rapidly, one superintendent of a large oil company devised a system of obtaining regular water-cut samples without incurring the expense of adding costly equipment or enlarging the existing tank facilities. The system is described, and consists essentially of weigh-meter which is fitted at each tank setting on the lease, and which records the gross fluid as it comes from the well, and of a constant-level arrangement for the water after separation in the tank. A. H. N.

1278.* Elevated Pumping Unit in Over-flow Area. Anon. *Oil Wkly*, 15.7.40, **98** (6), 36.—A pumping unit elevated on a platform in order to continue functioning during periods of overflow in the lease, and which is fitted with a special heater, as the oil is highly paraffinic, is described. A. H. N.

1279.* Raised Structure Guards High-pressure Well. Anon. *Oil Wkly*, 22.7.40, **98** (7), 12.—A well-head structure is described, which appears to have been designed with a view to ruggedness, safety for workers, and protection from damage by cattle, floods, and tornadoes. The tree is a 10,000-lb.-test type, and the high-pressure wells are 10,300 ft. deep.

A feature of the system is a flow-valve in the tubing string which closes automatically against high rates of flow—a valuable asset if surface connections are broken by flood or a tornado. Another feature is a low-pressure manifold connected to the tree by pipe-bends which are effective in abating turbulence. A. H. N.

1280.* Industry Faces Economic Crossroads. W. L. Baker. *Oil Wkly*, 29.7.40, **98** (8), 41–45.—It appears that revenues are diminishing from producing wells, and that unless the problem is solved logically it may assume serious proportions. Five possible solutions are discussed. The first three are: (1) to raise the price of crude; (2) to increase consumption; (3) to improve methods of development at cheaper costs. All three suggestions suffer from the fact that they are beyond the immediate control of the operator and, further, if they were successful they would induce additional drilling activities, and thus, after a temporary relief, the problem would have to be faced again in a probably more acute condition.

Wider well spacing and unit control of pools are offered as the only logical ways of treating the problem. Advantages of wider spacing are listed as, briefly, (1) wider spacing will readjust the equilibrium of supply and demand; (2) capital expenditure per acre developed is less with wide spacing; (3) fixed charges are less; (4) daily allowable per well will be greater as wells decline; (5) operating costs, gross and per barrel, are less; (6) dissipation of reservoir energy is reduced; (7) volume of salt water handled is less; (8) part of funds now used in intensive drilling becomes available for wildcatting and discovery of new fields.

Unit operation is advocated because there is maximum economy of operation; fewer wells are needed; reservoir control is made practicable; individual risk is minimized; a stabilizing effect is imposed on the market; it increases per-acre yield of oil; an increased value is created for gas; it permits adjustment of production rate to the producers' needs; it effects savings on pipe-lines, storage tanks, and plant capacity; it makes possible the practices of pressure maintenance, repressuring, water flooding, and recycling. A host of other reasons are advanced. A. H. N.

1281.* Prorated Production A Minimum Profit Level. Anon. *Oil Wkly*, 29.7.40, **98** (8), 46–52.—The steadily diminishing revenues from producing wells in recent years have already reached the minimum economic level at which numerous wells may be operated, and it is claimed that if the trend continues its downward tendencies oil-producers will be faced with an extremely serious financial situation in the very near future. It was felt that despite the probable lack of absolute accuracy there was a need for an estimated measure of the relationship between costs and income. Consequently, by use of data known and generally accepted by the industry and a system of weighted averages and "present worth appraisals," an attempt was made to compare the average prospects for profits from new drilling development that were in existence in the eight prorated states during each of the years from 1935 to 1939. No absolute accuracy was claimed for the results, but they were believed to possess a certain validity.

An acute condition of diminishing income return per dollar invested is shown. This paper does not suggest the remedy, but only the situation is discussed. The remedy is discussed in a preceding paper. [Cf. abstract no. 1280.] A. H. N.

1282.* Increased Efficiency through Use of Smaller Pumps. T. P. Sanders. *Oil Gas J.*, 4.7.40, **39** (8), 45.—In wells pumped on the beam more production is lost due to installing pumps that are too large than because of using pumps that are too small. Two general classes of wells commonly suffer from too large pistons:

(1) Deep wells, where the string of sucker rods is more than 4000 ft. long. In such a well large plungers cause excessive rod stretch, resulting in losses due to loss of stroke length in excess of the gain of using the large plunger.

(2) Any well in which a pump-off condition occurs. In such a well a relatively small pump reduces the polished-rod load, and slippage past the plunger is minimized. Also if pounding of the fluid does occur, the small plunger minimizes the effects of the shock on the equipment.

A table gives maximum recommended plunger sizes for wells of various depths, from 4000 ft. (maximum plunger diameter, 2¼-in.) to 8000 ft. (maximum diameter, 1¼-in.). A. H. N.

1283.* Operating Efficiency Increased by Standardization. N. Williams. *Oil Gas J.*, 11.7.40, **39** (9), 57.—Standardization of all lease production equipment is being carried out by a Texas company. This not only applies to completely new installations, but also as old lease facilities, such as stock-tank batteries and separator hook-ups, well connections and assemblies, and other units need attention or replacements they are made to conform to the uniform types and designs adopted as the field is developed. The paper details various items so standardized both in surface and subsurface pumping equipment.

It is claimed that this work is contributing markedly towards efficiency of working the field, towards reducing greatly the number of items necessary to be carried in warehouse stocks and towards simplifying and facilitating installation and maintenance of the various operating units. A. H. N.

1284.* Subsurface Pump Performance. S. B. Sargent. *Oil Gas J.*, 11.7.40, **39** (9), 58.—*Paper Presented before American Petroleum Institute.* The first part of this short paper deals with theoretical and actual sequence of events which occur in a subsurface pump in action. Typical dynagraph data are presented for various stages of plunger movement in the barrel, and these are explained and interpreted in the latter part. Cards are also shown when the pump is handling gas with the oil.

It is concluded that there are a great number of factors influencing pump operation that cannot be readily determined without the use of instruments to measure their relative magnitudes. Each factor taken by itself is quite simple and is easily explained by fundamental laws of either hydraulics or mechanics. A. H. N.

1285.* Chart for Computing Volume. Anon. *Oil Gas J.*, 11.7.40, **39** (9), 65.—A chart is presented for computing the volume of gas being injected into input wells, or of gas obtained at casinghead in calculating gas–oil ratios and using an orifice meter. Given orifice size in inches, specific gravity of gas (compared to air), gauge, and differential pressures in lb./sq. in. and inches of water, respectively, the volumetric rate of flow of gas in cu. ft./day is found to an accuracy of 5%, using the chart to the scale which is presented. On a considerably larger scale it is believed that the chart could be read to a maximum error of 2%, or practically to the error of the usual orifice meter employed.

An example illustrates the use of the chart. A. H. N.

1286.* Low Producing Rates Waste Reservoir Pressure. T. P. Sanders. *Oil Gas J.*, 11.7.40, **39** (9), 66.—Actual field evidence indicates that a low rate of flow can be, and usually is, even more wasteful of reservoir pressure than is wide-open flow. While open flow is not recommended, it is preferable to too severe restriction, which tends to bleed off an abnormally high proportion of gas, leaving "dead" oil in the reservoir.

Wells with small allowables that are made to flow at low rates for 24 hr./day almost invariably suffer from extreme separation of oil and gas in the tubing. Correction of this condition can be brought about simply by adopting faster flow, with minimum gas–oil ratio, and shutting the wells in for the remainder of the day after the allowables have been made. For determining the best rate of flow for a well there is no substitute for gas–oil ratio.

For wells which use a 2-in. tubing, material assembled shows that wasteful conditions usually occur when the rate of flow is restricted below 10 brls./hr. A. H. N.

1287.* Economic Aspect of Water Flooding. L. C. Converse. *Oil Gas J.*, 18.7.40, **39** (10), 18–19.—This paper is devoted to economic studies in the Mid-Continent

fields. The crude is produced at low cost as compared with deeper and newer fields, and this fact is due, in the main, to three causes: (*a*) discovery and leasehold cost; (*b*) development cost; and (*c*) lifting cost, all of which costs are low. After a conservative estimate, leasehold costs are given at 6 cents/brl.

The development costs are again low, due for instance to the fact that for a water-flooding project most of the wells required are already drilled. The lifting costs are affected by the size of the shot hole, the effective permeability of the sand, the viscosity of the oil, the pressure applied, and the resistance or distance between input and output wells. These factors are studied specifically in Bartlesville sand.

In estimating the total cost of a barrel of crude recovered by water flooding these old sands, 6 cents are allotted to leasehold cost, 10 cents to development, 10 cents to lifting, 7 cents to engineering and supervision, and 10 cents to overhead charges. Thus total cost of the crude is 43 cents/brl. A. H. N.

1288.* Electrifying Oil Properties and Service Restoration Systems. O. Dowzer. *Oil Gas J.*, 18.7.40, **39** (10), 41.—In the electrification of oil-field properties several factors must be considered in determining whether the power is to be purchased or privately generated. These factors, methods of installing secondary circuits, and means of restoring service are discussed.

During the past few years the central lease power plant or skid unit for the purpose of generating current to serve fifteen or twenty motor-driven pumping units has become quite popular. These units usually consist of small gas or diesel engine-driven generators equipped with automatic governors and switches generating at 440 volts. The motors run on 440 volts, whilst a transformer steps the voltage down to 110 volts for lighting. The system is economical, and two men per shift are sufficient to operate it.

It is pointed out that in service restoration generators are designed to take the full load of all motors working simultaneously, but not the starting loads of all motors simultaneously. This is due to the fact that a motor requires from three to five times its normal full-load running current for starting.

One method, requiring least investment, is to open the switches on all wells after a shutdown and to start them individually on service restoration. On the other hand, there is the most expensive of three methods suggested, that of fitting an under-voltage coil to each motor, and an automatic time switch. The motors will be automatically switched off on a breakdown, and on restarting any given number of motors may be started consecutively at, say, 10 or 15 sec. intervals.

The third method is intermediate in costs and time-consumption. Wells are fitted with under-voltage coils to shut them down on a breakdown in the generator, but are started by hand. The three methods are compared and contrasted. A. H. N.

1289.* Intermittent Injection Helpful in Repressuring. T. P. Sanders. *Oil Gas J.*, 18.7.40, **39** (10), 54.—The basis for this short contribution is that experience in gas-drive work has shown that oil production will increase with increased gas input up to a certain limit. Beyond this an increase in gas may retard production. Further increase will cause excessively high producing gas–oil ratios, indicating channelling.

When intermittent injection is used, the permeable channels are invaded by oil from the adjacent tight sands during the shutdown periods. This oil is then moved to the producing wells when the gas is turned on. A. H. N.

1290.* Recent Trends in Petroleum Production Research. L. C. Uren. *Petrol. Engr*, Midyear, 1940, **11** (10), 17–20.—Professor Uren deplores the short-sightedness of certain executives who spend hundreds of thousands of dollars in wildcatting and yet are reluctant to invest like amounts in research for better methods of recovery. Much of the advance in oil-field development and petroleum production methods achieved during recent years has been a direct result of research.

The paper reviews recent research projects on production and a list of 46 references is appended. Studies of reservoir fluids and reservoir mechanics are discussed, and these deal with phase behaviour of hydrocarbon mixtures, retrograde phenomena, mechanism of flow of gas, oil, and water through formations, and general principles of drainage. Formation sampling, sidewall sample takers, porosity, permeability,

and other core-analysis problems are next reviewed, together with researches on mud fluids, cementing problems, and gravel-packing. Finally, the materials used in well casing and drill-pipe manufacture are briefly studied. A. H. N.

1291.* Recent Trends in Production Methods. H. L. Flood. *Petrol. Engr*, Midyear, 1940, **11** (10), 35.—The trend of production methods appears to be towards the maximum utilization and conservation of reservoir energy. It appears also that light, inexpensive equipment that can be reclaimed and changed if its further use is not warranted is being used in increasing quantities.

Recording and interpreting adequate well data are being recognized as being of fundamental importance.

There has been a tremendous increase in the thought and attention accorded in the last year to methods of secondary recovery. Of greater significance than this is the fact that many fields are planned with a view to secondary recovery at some later stage of development, even at the very beginning of the exploitation and development programmes. Gas-repressuring and water-flooding are reviewed.

Pumping practices have seen improvements in load balancing, use of catenary pull rods and of electrically-powered units, better pumping engines, hydraulic pumping, gas anchors, and generally better technique. These are reviewed.

A. H. N.

1292.* Progress and Trends in Gas-lift Operations. S. F. Shaw. *Petrol. Engr*, Midyear, 1940, **11** (10), 50.—Under present restricted production schedules, artificial gas-lift methods do not receive the attention they would command if the crude oil requirements were more nearly in line with the producible supplies.

Natural flow as a form of natural gas-lift process is briefly studied. A review is next given of artificial gas-lift as practised in Oklahoma City, Rodessa, various fields in Texas, Louisiana, Pennsylvania, and California, in Peru, and in other foreign fields under separate sections.

Restricted production resulted in the necessity of closing-in wells periodically, and hence the need for developing kick-off valves became great. A more scientific application of kick-off valves and "flow" valves than has been possible hitherto is gradually being worked out.

Studies into casing sizes and cost of gas and gas-lift are briefly reviewed and references are given. A. H. N.

1293.* Developments in Production Practice in California. W. A. Sawdon. *Petrol. Engr*, Midyear, 1940, **11** (10), 63.—At the present time there are approximately 18,850 wells in California capable of producing oil, 15,000 of which are actually producing. Nearly 90% of these are on the pump.

In several fields gas zones above the oil-producing formations have been utilized to produce the oil, controlled in a manner which has conserved the gas supply. This is being done with bottom chokes placed in the tubing string opposite a gas zone which has been separated from the lower oil formation by a packer.

There has been an increase in the use of hydraulic pumps, and in many cases multiple installation is used in which a number of wells receive power oil from a central location. In one certain field ten wells are produced thus.

A new method introduced recently in gas-lift districts is to put a plunger-lift shoe on the tubing when it is run for gas-lift; then when plunger-lift operation is necessary the plunger is dropped-in and the necessary surface connections are made.

A. H. N.

1294.* Progress and Trends in Water-flood Districts of Appalachian Area. P. M. Phillippi. *Petrol. Engr*, Midyear, 1940, **11** (10), 76.—Perhaps one of the greatest strides forward in the art of water-flooding is the newly aroused interest in the shooting, and in particular the selective shooting, of wells. Eight major merits of selective shooting are enumerated, such as increased oil production per acre, decreased ultimate water consumption, quicker production and return of investment, etc.

There is a significant increase in the electrification of water-flooded areas, and this is probably due to the abnormally low price of this premier-grade oil, to proration, and to the cheap, easily available utility electric power.

The question of well spacing in a flooding area is chiefly an economic one, and ought to be solved on that basis, taking into account the properties of the particular sand under consideration.

Adoption of wide spacing means using high pressures. There is a critical pressure above which by-passing of the sand occurs to a serious extent. The maximum pressure to be used is just below the critical pressure, and it should not exceed 1 lb./ft. of depth. A. H. N.

1295.* Electric Power for Oil-well Pumping. J. E. Moody. *Petrol. Engr*, July 1940, **11** (11), 43.—Motors in use on modern pumping equipment may include one of the following: (1) single-rated, single-speed, normal-torque; (2) single-rated, single-speed, high-torque; (3) Star Delta, double-rated, single-speed; (4) double-rated, two-speed, constant-torque; and (5) double- or triple-rated, single-speed. The first two are the most generally used. The single-rated, single-speed, normal-torque motor is of the general purpose classification, but should an automatic time switch be installed, the second type is preferable, as it affords added safety factor on starting the well.

The performances of the various types are contrasted and compared with each other. Specimen calculations are given to determine the rating of a motor to be installed on a well. Recent installations indicate that 10-h.p. motors are generally ample to take care of present and future requirements. A. H. N.

1296.* Motor-driven Submerged Power Pump. W. A. Sawdon. *Petrol. Engr*, July 1940, **11** (11), 67.—A rodless pump for oil wells is described and its test performance figures and charts are reproduced. It is suitable for pumping 250 brls. or more of oil/day. Tests were performed at 3000 and 5000 ft. depths, respectively.

Briefly the pump and motor consist of an electric motor and a hydraulic transmission system to convert the high-speed rotary motion of the motor into a slow reciprocating motion, which is utilized in a conventional oil-well pump. The entire unit is enclosed in an outer jacket, the top of which is attached to the tubing production string and the bottom to the oil-well pump. Flow of oil after leaving the pump is upward through the annular space between the outer jacket and the case of the pumper mechanism. The passage of crude oil around the inner assembly keeps the motor and the power oil at approximately the same temperature as that of the crude itself.

A full description of the pump and its action is illustrated by a sectional drawing of the pump. The pump may be fitted with any ordinary auxiliary equipment such as gas-anchors and a blind cage for sandy wells. A. H. N.

1297.* Deepening and Completing a Well in the Lisbon Field. Pt. 6. P. D. Torrey and F. H. Miller. *Petrol. Engr*, July 1940, **11** (11), 70–72.—In this part of the paper production tests are detailed. The super-compressibility of the gas encountered is given in graphical form. The gravity and natural gasoline content of the separated gas are then studied and a summary of all the production tests performed on this particular well is given.

Bottom-hole pressure, physical analysis of the reservoir conditions, and recommendations for efficient rate of production conclude this part.

The paper will be concluded in a seventh part.

(Cf. abstracts Nos. 608, 754, 896, 994, and 1094 for previous parts.)

A. H. N.

1298.* The Behaviour of Oil and Gas under High Pressures and Temperatures. Pt. 2. H. T. Kennedy. *Petrol. Engr*, July 1940, **11** (11), 77.—Experiments are described which have been performed under formation conditions and on a mixture of oil and gas as obtained from the reservoir. The apparatus consists of a glass pressure tube into which the oil is measured, and a measured volume of gas is introduced by mercury displacement. Pressure is applied, after mounting the glass tube in a metallic container, by a pump. Stirring is obtained by the reciprocating motion of an electromagnet on a small steel ball inside the tube. Temperature is controlled by means of

an oil-bath. Volumes are measured by means of a cathetometer reading to 0·001 mm. Pressures are measured by a dead-weight gauge.

Charts giving the pressure-volume relationships are reproduced and analysed. It is shown that in a certain condensate reservoir, the original pressure of which has been 4200 lb./sq. in., 82% of the condensate will be in the reservoir when the last well is plugged in and abandoned, unless some pressure-maintenance system is adopted. Different systems are discussed. A. H. N.

1299. Production Patents. A. M. Herbsman. U.S.P. 2,206,187, 2.7.40. Appl. 19.6.37. Method of increasing production of oil wells consisting of introducing a solution of hydrochloric acid gas absorbed in a liquid which is immiscible with water, into the well.

J. M. Olson. U.S.P. 2,206,329, 2.7.40. Appl. 8.11.39. Tank gauge.

C. L. Murphy. U.S.P. 2,206,363, 2.7.40. Appl. 7.9.39. Valve for an oil tank.

D. W. Hoferer. U.S.P. 2,206,461, 2.7.40. Appl. 14.3.38. Deep-well pump.

K. P. Neilsen. U.S.P. 2,206,466, 2.7.40. Appl. 29.2.36. Duplex pump for deep wells.

C. A. Combs. U.S.P. 2,206,835, 2.7.40. Appl. 27.11.37. Well-control equipment consisting of an inclined separating tank and a vertical tank connected to a well and to each other and a level controlling float in the vertical tank.

S. V. Dillon. U.S.P. 2,207,001, 9.7.40. Appl. 11.10.37. Well equipment consisting of an inflatable and deflatable packing and a source of pressure for such means.

G. R. Linville. U.S.P. 2,207,019, 9.7.40. Appl. 14.1.38. Combination packer.

H. R. Toney. U.S.P. 2,207,033, 9.7.40. Appl. 23.5.38. Apparatus for flowing wells.

C. S. Crickmer and R. A. Lamb. U.S.P. 2,207,118, 9.7.40. Appl. 7.7.38. Flow valve for wells.

W. R. Millican. U.S.P. 2,207,129, 9.7.40. Appl. 5.10.37. Flow valve for wells on gas-lift.

H. C. White. U.S.P. 2,207,184, 9.7.40. Appl. 29.9.37. Method of conditioning wells by using a foraminate body and later introducing reagents which attack this body and open its interstitial spaces.

J. A. Jesson and S. C. Kyle. U.S.P. 2,207,255, 9.7.40. Appl. 11.7.39. Casing-head for use on upper end of well casing enclosing a string of flow tubing terminating in a flanged tubing hanger.

J. M. Reynolds, W. M. Newton, and J. T. Ledbetter. U.S.P. 2,207,334, 9.7.40. Appl. 20.3.39. Method and apparatus for placing a filter body in a well.

P. H. Jones and A. L. Blount. U.S.P. 2,207,348, 9.7.40. Appl. 20.10.36. Determination of the connate water content of oil-producing formations by using a chemical tracer in the drilling fluid and analysing for it in the core.

E. J. Ashbrook. U.S.P. 2,207,448, 9.7.40. Appl. 13.8.37. Bottom-hole well plug which expands by means of a ratchet and pawls.

J. R. Yancey. U.S.P. 2,207,471, 9.7.40. Appl. 27.1.40. Casing-head with a relatively wide foundation ring.

J. R. Moser. U.S.P. 2,207,518, 9.7.40. Appl. 5.10.37. Pipe joint for surface pipes.

D. G. Hefley and J. B. Stone. U.S.P. 2,207,733, 16.7.40. Appl. 10.10.38. Treatment of wells with hydrochloric acid and a small quantity of oil.

H. A. Reimers. U.S.P. 2,207,759, 16.7.40. Appl. 10.8.38. Treatment of earth and rock formation with acid solution and then liquid silicate mixture which gels subsequently.

J. P. Neel. U.S.P. 2,207,937, 16.7.40. Appl. 15.11.38. Pumping-well hook-off device.

R. R. Kyner. U.S.P. 2,208,036, 16.7.40. Appl. 1.6.37. Well-flowing apparatus and method.

C. J. Somers. U.S.P. 2,208,087, 16.7.40. Appl. 6.11.39. Electric heater for oil wells to be inserted into casing.

J. O. McMillan. U.S.P. 2,208,193, 16.7.40. Appl. 10.12.36. Pneumatic displacement pump.

E. St. E. Kilby. U.S.P. 2,208,461, 16.7.40. Appl. 19.10.38. Pump piston.

J. G. M. López. U.S.P. 2,208,466, 16.7.40. Appl. 10.11.38. Gas and oil separator.

L. D. Mowrey. U.S.P. 2,208,468, 16.7.40. Appl. 15.7.38. Rod-line carrier.

W. F. Rurup. U.S.P. 2,208,775, 23.7.40. Appl. 9.5.39. Automatic by-pass valve for oil well-packer to permit passage of well fluid upward, and means with check valves to permit downward flow around this passage, but not in the opposite directions.

A. H. N.

Hydrogenation.

1300. Patents on Hydrogenation. H. E. Potts. E.P. 523,649, 18.7.40. Appl. 18.10.38. Process for the destructive hydrogenation of carbonaceous materials containing solid matter in dispersion with hydrogen or gases containing hydrogen under high pressures and at high temperatures. A tube preheater is used having return bends in which interchangeable tube-like pieces are inserted constructed of or lined with alloys, or coated with high-melting enamels having a Brinell hardness of over 400.

J. C. Vlugter. U.S.P. 2,206,376, 2.7.40. Appl. 15.1.37. Process for non-destructive catalytic hydrogenation of olefins by passing vapours of olefinic hydrocarbons having a boiling point within the gasoline range and being formed by the polymerization of mono-olefins, together with water vapour and a gas containing free hydrogen, in contact with a hydrogenation catalyst.

H. B. M.

Polymerization.

1301. Patent on Polymerization. Les Usines de Melle. E.P. 522,818, 27.6.40. Appl. 17.12.38. Process of olefin polymerization which consists in treating a gaseous olefin with a hot aqueous polymerizing reagent of a concentration of at least 50%. The conditions are such that only the dimer and small amounts of higher polymers are formed, and are removed from the polymerizing reagent as soon as they are formed as a predominantly dimer–water azeotropic mixture by azeotropic distillation.

H. B. M.

Refining and Refinery Plant.

1302.* Treatment of Crude Oil from Tupungato at the Campana Refinery. A. Piccioni. *Bol. Inform. Petroleras*, March 1940, XVII (187), 81–86.—This article describes the method of dealing with a shipment of crude oil of 36,300 m.^{3}. A complete analysis is given of the crude oil and description of a topping plant with a Foster Wheeler furnace. Full particulars of the products and characteristics are provided. Particulars are also given of a coke still producing gas oil for cracking, and also details of a Cross cracking

plant and of the product obtained, and lastly the naphtha cracking plant. Finally the figures are given for the results obtained from each of the six processes employed.
H. I. L.

1303.* Fundamentals of Solvent-refining Operation. E. W. Gard and E. G. Ragatz. *Oil Gas J.*, 6.6.40, **39** (4), 49.—The more important characteristics of an ideal solvent are: (1) high efficiency and selectivity for the quality of product desired; (2) high degree of stability; (3) ready gravity separation of its extract—raffinate phases; (4) residual traces left in the oil should have no deleterious effect; (5) ease of recovery; (6) non-corrosivity; (7) non-toxicity; (8) fluidity at atmospheric temperature; (9) cheapness. Correct evaluation of items 2–9 is straightforward, but item 1 is more difficult. It is accordingly considered in detail, the theoretical bases being contrasted with those of rectification. An experimental 12-stage continuous extraction unit, using benzol–SO_2 for the treatment of mixed base oils, has been used to evaluate the different factors involved. One series of tests provided data on the extent of increased yields with increased solvent ratios. Thus, when running to a 0·808-v.g.c. (87·5-v.i.) raffinate, increasing the solvent–oil ratio from 400% to 1060% increased the yield from 27% to 46%. The effect of varying the reboiling temperature indicates the necessity of proper manipulation of this stage in order to control solvent ratios. The importance of the point of entry of the incoming feed was shown by tests in a laboratory treater utilizing phenol and consisting of two 40-ft. treating columns instead of the alternate mixer-settlers of the previous SO_2 plant. Changing the inlet from the bottom of the second column to the top decreased the solvent requirement from 400% to 300% and gave a slightly higher yield of a slightly better-quality raffinate. Increasing the extraction temperature from 167–170° F. to 190–195° F. enabled the solvent ratio to be reduced from 375% to 300%. Further temperature increases would be possible, limited, of course, by the approach to the miscibility temperature. A comparison of phenol and benzol–SO_2 indicated that while similar solvent ratios were required for a 65-v.i. raffinate, 4½ times as much benzol–SO_2 as phenol was required for a 90-v.i. raffinate. Comparative yields for benzol–SO_2 to phenol were 0·93–1 for 65-v.i. raffinate and 0·60–1 for 90-v.i. raffinate. By plotting yield, solvent ratio, and raffinate quality data for these runs it is found that a substantially straight-line relationship exists between raffinate v.g.c. and volume per cent. raffinate for any given solvent ratio. At the lower end all solvents show a marked break in the slope, this break occurring at different v.g.c. values and different solvent ratios for different solvents. Thus for phenol treatment the break occurs at 92·5 v.i. and for SO_2 at 60 v.i. If, therefore, the operations are attempted below the solvents' break point, the solvent ratios required for a given yield efficiency will rapidly increase with relatively small increases in raffinate quality.
C. L. G.

1304. Patents on Refining. Standard Oil Development Corporation. E.P. 522,605, 21.6.40. Appl. 12.12.38. Treatment of mineral oil with selective solvents by distilling in a batch still, condensing the distillate obtained thereby into a number of consecutive fractions of narrow but progressively higher boiling range, and treating these fractions consecutively with a selective solvent.

E.I. Du Pont de Nemours. E.P. 523,451, 15.7.40. Appl. 29.12.38. Inhibition of deterioration of mineral hydrocarbons, etc., by incorporating therewith an arylidene amide obtained by condensing a polyamine with a proportion of an *ortho*-hydroxy-substituted aldehyde, which is aromatic in nature.

H. T. Bennett. U.S.P. 2,206,151, 2.7.40. Appl. 15.1.36. Method of avoiding thickening of the liquid oil during the process of sulphurizing fatty and mineral oils. This is achieved by heating a mixture of the liquid oil and sulphur in the presence of an aromatic amino-compound, maintaining the oil in liquid form during heating, and limiting time of operation, to prevent substantial thickening.

W. A. Schulze. U.S.P. 2,206,921, 9.7.40. Appl. 6.10.36. Method of sweetening gasoline stock containing organic sulphur compounds of the mercaptan type by contacting with a zirconium oxide catalyst. The mercaptans are converted into hydrogen sulphide, which is thereafter separated from the gasoline stock.
H. B. M.

Analysis and Testing.

1305. Analysis of Petrols. Physical & Physico-Chemical Methods. — Abert. *Sci. et Ind.*, 1940, 290 bis (Supplement to *Revue Mécanique*), 53–60.—The methods discussed are: (1) the use of Verdet's law in the magnetic rotation of the plane of polarization of light; (2) use of the Gladstone–Dale and the Lorenz–Lorentz formulæ for specific refraction. These properties are highly constitutive, and give a clear distinction between the paraffins and naphthenes and the aromatic hydrocarbons, but they are of limited value, as they do not discriminate between the paraffins and naphthenes. These can be distinguished by: (3) critical solution temperature, (4) infra-red absorption; each hydrocarbon has its own series of absorption bands; thus, it is possible to distinguish between straight-chain and branched-chain paraffins, and hence between pro- and anti-knock paraffin hydrocarbons. This method has not, so far, been well developed, and is not accurate for quantitative investigations except for two component fractions. (5) Raman effect; each hydrocarbon possesses its own Raman frequencies, which are typical also of its homologues. R. D. S.

Motor Fuels.

1306.* Motor Fuels of the Present and Future. G. Egloff. *J. Inst. Fuel*, June 1940, **13** (72), 175.—A comprehensive survey is presented of methods of production, properties, and fuel value of a series of petroleum, coal, synthetic, and other motor fuels and components. These include the following processes: distillation, thermal and catalytic reforming, thermal and catalytic cracking, production of polymer gasoline, *iso*-octane gasoline, catalytic dehydrogenation and thermal cracking of gaseous paraffins to produce olefines for further processing, alkylated gasolines (sulphuric acid and thermal processes), aviation safety fuels, compressed gases, and such fuels as ammonia, hydrogen, acetylene, and coal dust. Statistical data on the economic possibilities of the dehydrogenation process in conjunction with polymerization and *iso*-octane production and a note on the chemical structure of compounds in relation to their octane rating are also presented. C. L. G.

1307. Patents on Motor Fuel. P. B. Onderdonk. U.S.P. 2,207,894, 16.7.40. Appl. 8.12.38. Preparation of an alcohol fuel of the nitrocellulose-gel type which has distributed therein a small amount of asbestos in the form of individual fine fibres. The latter are in sufficient quantity materially to reduce the irregularity of burning which would otherwise result from the presence of the nitrocellulose.

R. B. Rathbun. U.S.P. 2,208,105, 16.7.40. Appl. 28.8.37. Production of a stable motor fuel composed of a light-coloured gasoline stabilized by anthracene and lecithin, the amount of anthracene and lecithin not exceeding 15 lb./1000 brls. of fuel respectively.

T. B. McCulloch and J. E. Pollock. U.S.P. 2,209,204, 23.7.40. Appl. 11.3.38. Preparation of a motor fuel having a vapour pressure between 6½ and 7½ lb. Reid at 100° F. The fuel consists of substantial proportions of *iso*pentane, *iso*propyl ether, and a branched-chain saturated paraffin containing at least 8 carbon atoms in the molecule blended to produce a fuel having 12–40% distilled Engler at 158° F. H. B. M.

Lubricants and Lubrication.

1308.* Piston-ring Coatings and their Effect on Ring and Bore Wear. M. M. Roensch. *J. Soc. aut. Engrs*, 1940, **46** (5), 221–228.—Piston-ring scuffing most frequently occurs during the break-in period; it has been noticed for some time, and often leads to excessive bore and ring wear and high oil consumption. Methods of treating the surfaces of piston rings have been developed which aid in preventing scuffing during the break-in period. The coatings may be classified as chemical or metallic. The

chemical are: Ferrox, an iron oxide; Granoseal, an iron–manganese phosphate; Graphitox and Grafotox, a zinc–iron phosphate with colloidal graphite; and Surfide, ferrous sulphide. The metallic coating is electrolytically deposited tin.

The oxide coating consists of two layers, their total thickness being 0·0003 in. It is mildly abrasive, so that the ring itself polishes high spots from the bore; the softer outer layer permits rapid seating and the harder layer reduces the rate of wear. The phosphate coatings are softer than the raw iron, which gives them a quick initial seating and lapping action. These rings are capable of adsorbing and retaining considerable amounts of oil, which may help to prevent scuffing. The etched surface of Surfide-treated rings likewise acts as an oil reservoir, and the iron–sulphide coating has extreme-pressure characteristics. The metallic (tin) coating is soft and plastic, thus preventing localized pressure. All these coatings possess anti-welding properties.

The author has conducted rapid break-in tests which resulted in severe scuffing of untreated rings, but the treated rings withstood the same procedure with no signs of scuffing; these results are illustrated by numerous photographs. On road tests, coated rings showed 25% less wear, and field experience shows a marked reduction of oil-consumption complaints. K. A.

1309. Aviation Lubricants. P. Lion. *Sci. et Ind.*, 1940, 290 bis (Supplement to *Revue Mécanique*), 67–76.—The extreme conditions in which an aircraft lubricant has to function demand an oil of the highest quality. The necessary properties are high viscosity index, high specific heat and thermal conductivity, high oiliness, low carbon value, low cold test, no corrosion of metals, and good oxidation characteristics. Formerly, castor oil was an ideal lubricant, but with the rapid advance in performance of the aero engine the conditions became much more severe than could be withstood by castor oil, and the use of mineral oils is practically exclusive. The French Air Ministry specified two grades of mineral aircraft engine lubricant: "heavy" and "medium heavy" defined by their viscosities in absolute units at 35° and 100° C. In addition, the ratio between the viscosities at the two temperatures were fixed, and flash point, cold test, and acidity were specified. A catalysed ageing test was carried out, after which viscosity increase and hard asphalt were measured. Other tests, non-standard, but often carried out and giving much useful information on behaviour are: specific heat, friction tests on the Woog and on the Charron machines, Conradson carbon residue, distillation, and interfacial tension with water. Examination of the oil after use is carried out with reference to the effect of the oil on the engine and vice versa; it includes measurement of the change of viscosity, acidity, carbon residue, and estimation of the content of diluent, ash, and products of oxidation. Correct interpretation of these sheds much light on the best lubricant for aeroplane engines. In order that such an oil be obtained, the properly selected crude must be subjected to careful distillation, after which the appropriate fraction undergoes deasphaltization, dewaxing, and filtration. Solvent refining is an advance which now enables the finest product to be obtained from the crude. Finally, oils thus refined can be still further improved by blending in special addition agents, chosen as the result of exhaustive tests, to depress the pour point, flatten the viscosity curve, or to inhibit oxidation or corrosion. R. D. S.

1310. Patents on Lubricants and Lubrication. Standard Oil Development Corporation. E.P. 523,524, 16.7.40. Appl. 21.7.39. Improvements in blending agents for lubricating oils. The agents found to be most satisfactory fall within the class of alkyl- or aryl-substituted aromatic phosphite or thiophosphite esters which contain further substituent hydroxyl or mercapto groups attached directly to the aromatic nucleus.

E. W. Adams and G. M. McNulty. U.S.P. 2,206,245, 2.7.40. Appl. 10.6.36. Preparation of a lubricating composition consisting of a mineral lubricating oil and a small amount of an alkyl xanthic disulphide.

B. H. Lincoln, W. L. Steiner, and A. Henriksen. U.S.P. 2,206,573, 2.7.40. Appl. 16.9.38. Production of a lubricating composition consisting of a major proportion of hydrocarbon oil and a minor proportion of a halogenated alcohol.

C. F. Prutton, A. K. Smith, and H. E. Johnson. U.S.P. 2,208,161, 16.7.40. Appl. 19.10.39. Preparation of a lubricating composition consisting of a major proportion

of mineral oil, a relatively inactive organic sulphur compound, and a minor amount of an organic halogen compound.

H. P. Lankelma. U.S.P. 2,208,218, 16.7.40. Appl. 4.9.36. Improving a mineral oil capable of lubricating viscosity at high temperatures by incorporating therewith a small amount of a hydro-compound of the group consisting of hydroquinine, hydroquinidine, and hydrocinchomine. H. B. M.

Gas, Diesel and Fuel Oils.

1311.* Mechanical Atomization of Fuel Oil Heavier than Bunker C. G. C. Martinson. *Oil Gas J.*, 9.5.40, **38** (52), 80. (Paper before Fuels Division, A.S.M.E. Worcester, May 1940.)—The difficulties involved in the combustion of heavy cracking plant residues are discussed and a suitable type of burner is described.

The equipment in question consisted of boilers fitted with combination burners for oil and pulverized coal firing. When firing pulverized coal, the fuel is mixed with primary air at the pulverizers and delivered through the centre pipe of the burner assembly, whilst secondary air is forced through the air preheater by a forced draught fan and delivered to the burner assembly outside the pulverized coal pipe. For fuel oil only the secondary air supply is maintained. Difficulties were caused owing to the inadequate mixing of the fuel oil and air causing heavy coke deposits on the side-wall tubes. The oil flame failed to fill the throat, so that there was little mixing of the air and fuel, except at the outside of the oil flame cone. After a series of experiments with adjustable air vanes, selection was made of a mechanical atomizing burner tip developed for steel-mill purposes, which produced a wide angle of spray. It consisted of three atomizers set in a single burner head producing a flame cone angle of 120°. The burners can be withdrawn to a point at which the fire completely fills the throat without danger of infringement of the oil spray on the coal nozzle. Thus the atomized oil spray is forced into the secondary air stream, ensuring complete combustion with little excess air.

The burners have been in successful operation for 15 months, handling fuel of 800/1400 secs. S.F. at 122° F., operating costs comparing favourably with those given by pulverized coal. C. L. G.

1312. Patents on Diesel Oil. Standard Oil Development Corporation. E.P. 523,143, 5.7.40. Appl. 13.7.39. Manufacture of a compression-ignition fuel of the diesel type, consisting substantially of a hydrocarbon fuel to which has been added a small amount of an organic compound containing a thiocarboxylic acid radical. The latter imparts improved ignition qualities to the fuel.

Standard Oil Development Corporation. E.P. 523,522, 16.7.40. Appl. 21.4.39. Preparation of a compression-ignition fuel consisting of liquid hydrocarbons of the diesel fuel type and a small quantity of a soluble organo-metallic compound or organic salt of a metal selected from groups 2 and 5 of the Periodic System, and having an atomic weight above that of zinc.

H. G. Berger. U.S.P. 2,206,594, 2.7.40. Appl. 8.10.38. Preparation of an improved diesel fuel composed of a hydrocarbon fuel oil and a minor proportion of hydrogen persulphides and elementary sulphur in admixture therewith. H. B. M.

Asphalt and Bitumen.

1313. Preparation of Asphaltic Emulsions Obtained from the Petroleum at Comodoro Rivadavia. S. Bertolotto. *Bol. Inform Petroleras*, March 1940, XVII (187), 78–80.—The asphaltic residuals obtained from low-pressure distillation of the petroleum, as well as those produced from blown mixtures with extracts of lubricating oils arising in the treatment of the latter with sulphur anhydride, are not easily emulsified. Particulars are given of the methods which have to be adopted in order to produce

stable emulsions. Tables are given with particulars and characteristics of an emulsion of blown asphalt and one of Bitalco. A further table is given containing the specifications for asphaltic emulsions laid down by the National Road Board. H. I. L.

1314. Patent on Asphalt. T. B. Wayne. U.S.P. 2,206,589, 2.7.40. Appl. 2.1.34. Method of resolving petroleum emulsions by subjecting them to the action of a water-wettable alkylated paracoumarone resin. H. B. M.

1315. Patent on Road Materials. J. R. Geigy A.-G. E.P. 523,025, 3.7.40. Appl. 22.12.38. Use of pulverized condensation product as a stiffener for road materials consisting of small stones and tar. The product is obtained by condensing with an aldehyde a pinewood pitch of substantial insolubility in petroleum hydrocarbons. It is added to the road-surfacing material before or during its laying. H. B. M.

Special Products.

1316. Patents on Special Products. N.V. de Bataafsche Petroleum Maatschappij. E.P. 522,559, 20.6.40. Appl. 8.12.38. Separation of mercaptans from hydrocarbons with an aqueous solution of an alkali metal oxide containing a substantial amount of a mixture of an alkali metal alkyl phenolate and a sodium salt of a fatty acid having two carbon atoms in the molecule or a potassium salt of a fatty acid having one, two, or six carbon atoms in the molecule.

E.I. Du Pont de Nemours & Co. E.P. 522,643, 24.6.40. Appl. 16.12.38. Production of diethers of dimethylol urea by reacting substantially dry dimethylol urea and one or more normal, secondary, or *iso*monohydric alcohols at a raised temperature in the presence of anhydrous magnesium sulphate.

E.I. Du Pont de Nemours & Co. E.P. 522,644, 24.6.40. Appl. 16.12.38. Preparation of an ether of a methylol urea by reacting water-wet methylol urea with a monohydric alcohol in the presence of an acid catalyst and neutralizing the acid catalyst after substantial completion of the reaction.

Society of Chemical Industry in Basle. E.P. 522,658, 24.6.40. Appl. 19.12.38. Manufacture of nitrogenous naphthalene derivatives by causing a halogenated naphthalene which contains at least two halogen atoms, at least one of which is in a β-position, to react with a compound which contains at least one hydrogen atom attached to a nitrogen and contains the radical of a compound capable of being vatted.

Howard and Sons. E.P. 522,729, 26.6.40. Appl. 30.9.38. Manufacture of mannitol by subjecting fructose to catalytic hydrogenation in the presence of an added organic polyhydroxy compound and isolating mannitol from the product of hydrogenation.

I.G. Farbenindustrie A.-G. E.P. 522,835, 28.6.40. Appl. 19.12.38. Manufacture of trichloracetonitrile by chlorinating acetonitrile while exposing it to a source of light and to a temperature of 50–80° C.

E.I. Du Pont de Nemours. E.P. 522,840, 28.6.40. Appl. 19.12.38. Process for the manufacture of secondary alkyl monosulphonic acids or salts thereof.

J. D. Riedel and E. de Haen A.-G. E.P. 523,047, 4.7.40. Appl. 28.10.37. Process for the preparation of a trisubstituted barbituric acid.

H. Gudgeon and R. Hill. E.P. 523,080, 4.7.40. Appl. 20.12.39. Manufacture of 1-carbalkoxy- and -carbalkoxyalkoxy-butadienes-1 : 3 by heating alkyl or alkoxyalkyl α-acyloxy-β-ethylidene propionates in gaseous or vapour form at a temperature between 350° and 600° C.

Standard Oil Development Corporation. E.P. 523,248, 10.7.40. Appl. 31.10.38. Preparation of solid copolymers of *iso*butylene and butadiene by reaching 50–90% by

weight of *iso*butylene with 5–50% by weight of a butadiene at a temperature below − 50° C. in the presence of a catalyst consisting of an aluminium chloride–ethyl chloride complex.

Society of Chemical Industry in Basle. E.P. 523,396, 15.7.40. Appl. 3.10.38. Manufacture and application of ether and ester condensation products.

Society of Chemical Industry in Basle. E.P. 523,448, 15.7.40. Appl. 29.12.38. Manufacture of melamine from melam by heating the latter in a closed vessel at a temperature above 150° C. with anhydrous ammonia.

R. Greenhalgh. E.P. 523,466, 15.7.40. Appl. 30.12.38. Manufacture of monohydroxyalkylamides of higher fatty acids by the interaction of a methyl or ethyl ester or a glyceride of a higher fatty acid and a monohydroxyalkylamine having 2, 3, or 4 carbon atoms.

J. R. Geigy A.-G. E.P. 523,496, 16.7.40. Appl. 9.1.39. Improvement in the manufacture of condensation products from isatin derivatives and phenols. 1 mol. of an *N*-benzylated isatinsulphonic acid is condensed with about 2 mols. of a phenol or homologue thereof or of an ether of such a phenol or homologue.

Standard Oil Development Corporation. E.P. 523,520, 16.7.40. Appl. 16.3.39. Preparation of an emulsion consisting of a mineral oil, a water-soluble salt of an *iso*butyl phenol sulphonic acid, and oil-soluble salts of the sulphonic acid compounds obtained by the treatment of petroleum oils with strong sulphuric acid.

F. W. Kirkbride. E.P. 523,555, 17.7.40. Appl. 4.1.39. Oxidation of trichlorethylene by treatment with gaseous oxygen. The trichlorethylene is exposed to actinic radiation up to the stage wherein the reaction liquor has acquired an acid value of 3N and preferably between 15 and 20N. Subsequent oxidation is carried out at a temperature above 50° C.

British Celanese, Ltd. E.P. 523,635, 18.7.40. Appl. 11.1.39. Conversion of alkyl alcohols into polymerizable alkyl esters of unsaturated acids by oxidizing the alkyl alcohol to the corresponding unsaturated aldehyde, treating the aldehyde with a concentrated alkali solution, and converting the alkali salt thus produced into an ester by treating with an alkyl ester of an inorganic acid.

Armour and Co. E.P. 523,705, 19.7.40. Appl. 17.2.39. Preparation of a naphthalene containing as a plasticizer an amide of the general formula $R\text{CONH}R'$, wherein R is an alkyl radical containing at least nine carbon atoms, and R' is hydrogen, an aromatic or aliphatic hydrocarbon radical, or an aliphatic acyl radical.

H. B. Hass. U.S.P. 2,206,813, 2.7.40. Appl. 31.8.36. Production of nitrohydrocarbons by chemically combining. Substantially pure nitrogen dioxide and a saturated hydrocarbon containing more than 2 carbon atoms are contacted wholly in the vapour phase at a temperature of 300–600° C.

J. M. Weiss. U.S.P. 2,206,377, 2.7.40. Appl. 6.8.37. Production of maleic acid from benzene by passing benzene and air over a heated contact mass having a productive catalytic agent.

J. W. Putt. U.S.P. 2,207,552, 9.7.40. Appl. 8.12.36. Production of aromatic hydrocarbons and diluents and solvents of a predominantly aromatic hydrocarbon content the dilution ratio, kauri butanol, and dimethyl sulphate value of which closely approach or equal those of coal-tar aromatic hydrocarbons produced by the pyrolysis of coal.

W. E. Currie. U.S.P. 2,209,190, 23.7.40. Appl. 11.1.36. Manufacture of hydrocarbons from carbon oxides by subjecting a mixture of an oxide of carbon and hydrogen to the action of a Fischer–Tropsch catalyst at temperatures between 380° and 450° C. and at a total pressure between 10 and 20 atmospheres, but in the presence of sufficient diluting gas to ensure a partial pressure of combined reactants below 5 atmospheres.

H. B. M.

Detonation and Engines.

1317.* Economic Aspects of Light Airplane Engines. C. T. Doman. *J. Soc. aut. Engrs*, 1940, **47** (1), 284–290.—The author's organization has developed a basic design of 4-cyl. horizontally opposed air-cooled engine which is used both for commercial vehicle and light aircraft applications. Whilst there are numerous detail differences, the similarity of parts permits the use of the same production fixtures, with consequent reduction in cost of the aircraft unit. Both models use 73-octane fuel. The commercial engine develops 45 b.h.p. with 5·5 : 1 compression ratio; the aircraft engine 55 b.h.p. at 6·6 : 1. A description is also given of a 4-cyl. opposed engine developing 80 b.h.p. with 73-octane fuel. K. A.

Coal and Shale.

1318. Patent on Coal. J. Jannek. U.S.P. 2,208,514, 16.7.40. Appl. 11.9.37. Production of pulverulent motor fuel for coal-dust motors by treating solid extracts of coal with oxides of nitrogen in such a way that the initial material retains its loose pulverulent condition, and nitrogen and oxygen are incorporated with the coal extract. H. B. M.

Economics and Statistics.

1319.* Economics of Liquefied Petroleum Gases. J. W. Vaiden. *Oil Gas J.*, 23.5.40, **39** (2), 74. (N.G.A.A. paper Tulsa, May 1940.)

The economics of the utilization of propane and butane as domestic fuel, in central gas plants, as fuel for I.C. engines or as a blending agent and in polymerization and related processes is discussed. Conclusions reached are :—

(1) Extraction of propane and butane beyond the limits incidental to efficient recovery of natural gasoline is likely to prove uneconomical, it being calculated that the cost of the equipment necessary to recover 95% of the butanes amounts to \$4/\$15 per gallon of gasoline recovered (depending on the butane content).

(2) The extension of the marketing of propane as domestic fuel offers small possibilities of profit, owing to heavy investments necessary, increased competition, and expensive distribution costs in those sparsely populated areas where a market still remains.

(3) Butane is more economical to distribute, owing to the lower pressure and lighter containers used. Its use as domestic fuel has not been as highly developed as that of propane, but present supplies of butane are more than sufficient for this purpose, so that its future value will depend more on the demand for other purposes.

(4) The extension of the use of propane or butane in central gas plants offers possibilities, particularly for communal or private plants for the generation of electricity, operation of water and sewage pumps and refrigeration plants.

(5) The use of butane and/or propane as fuel for I.C. engines for farm machinery, trucks, and buses is well developed, and is now spreading into the oil-fields for drilling equipment. An increase in horse power of more than 56% with a 9·95 compression ratio using propane fuel or 19·3% with a 6·75 compression ratio using butane is shown over a 61 O.N. gasoline at a 4·38 : 1 compression ratio. Fuel savings of 30·9% have been shown with these gaseous fuels. No advantage is given unless the compression ratio is increased.

(6) It was calculated in 1934 that the incorporation of 5% of butane in motor fuel would save the industry \$55,000,000 per annum, chiefly due to lowering of crude oil requirements and saving of tetraethyl lead.

(7) Liquefied gases available in refineries near large centres of consumption offer competition with natural gasoline plants located at some distance from the point of distribution. The greater use of these gases for polymerization or alkylation would reduce this competition. At present these processes can only be considered in connection with refinery operations, since natural gas requires expensive cracking equipment to produce the necessary basic products, and, in addition, refineries possess the

necessary blending materials. Diversion of propene and butene from gasoline to polymerization plants will require the purchasing of additional quantities of butane. Its value as gasoline is estimated at 6 cents per gallon or as fuel at 0·7 cent per gallon, so that if half of the available butane–butene is used for each purpose, it can be replaced by butane for which as high as 3·35 cents per gallon can be paid. Alternatively, natural gasoline containing, say, 30% butane may be used to obtain the necessary volatility. C. L. G.

BOOK REVIEWS.

Physical Constants of Hydrocarbons. Volume 2. Cyclanes, Cyclenes, Cyclynes, and Other Alicyclic Hydrocarbons. By Gustav Egloff. Pp. 605. Reinhold Publishing Corp., New York, or Chapman & Hall, London. Price 72*s*.

On the occasion of the publication of Volume 1 of this series early in 1939, a reviewer wrote, "When the Universal Oil Products Co. publish a work composed entirely of data, statistics, and bibliography, petroleum chemists are assured without the recommendation of a reviewer that no organization is better fitted to compile such a book, so high is the reputation in the petroleum world of the Records and Filing Department of this Company."

That this opinion was whole-heartedly endorsed by petroleum chemists is evident from the widespread success of Volume 1, and there is no doubt that Volume 2 will achieve an equally appreciative reception.

The present volume follows the same system as the first—that is to say, it embodies all the available data on the principal physical constants of the hydrocarbons—namely, melting point, boiling point at various pressures, specific gravity and refractive index, each entry bearing the reference to the source of information. That novel and very valuable feature of Volume 1, the indication as to which of the data is considered the most reliable, has been retained.

Volume 2 deals with the alicyclic hydrocarbons (excluding the aromatic series) and covers the cyclanes, cyclenes and di-, tri- and tetra-enes, cyclynes (acetylenic types), spiro-hydrocarbons, and "hydrocarbons of known but unclassified structure," some of which, such as the carotenes, are of extreme complexity. Lastly, there is a miscellany of hydrocarbons of unknown structure and frequently fanciful names. Many of these are sesquiterpenes deriving their names from their natural origin.

In compiling this volume Dr. Egloff has had a much more difficult task in many ways than he had in the previous volume. The alicyclic compounds in the first place have received on the whole much less attention from chemists than the open-chain hydrocarbons, so that data are fewer and less reliable. Geometrical isomerism is a much more complicated phenomenon with cyclic hydrocarbons than with open-chain olefines, and in all but a few cases the spatial structure of the hydrocarbons described is entirely unknown, although very considerable alternative configurations are possible. Even nomenclature is confused. Chemists frequently term these hydrocarbons polymethylenes, naphthenes, and in some cases hydroaromatics and terpenes, as well as cyclanes (or -enes) and *cyclo*alkanes. Dr. Egloff's first and probably most difficult task was to decide on his system of nomenclature, which was required to cover an extraordinarily wide range of hydrocarbon types. He decided to base his system on the Geneva International Rules, though certain adaptations and amplifications proved necessary. This leads to some very formidable and complicated terminology, especially in the bicyclic terpene series. However, Geneva terminology is at any rate consistent, and can with practice (we suppose) be learned, so we must admit that Dr. Egloff has succeeded in a task which would daunt most chemists.

Petroleum chemists will not find as much in this volume as in the last of direct interest to them, for whereas the open-chain paraffins and olefines are met with at every turn in modern petroleum chemistry, the naphthenes so far have been a field little known, and not extensively employed in synthetic operations. Interest, however, has turned to cyclization, so that naphthenes are not likely to remain in the semi-unexplored territory they have hitherto occupied.

We can, therefore, repeat in all sincerity that this volume, like its predecessor, is one that all petroleum research laboratories should possess for purposes of reference, even though the rather formidable price of 72*s*. may cause hesitation.

F. B. Thole.

Industrial Plastics. By Herbert R. Simonds. Pp. xii + 371. Sir Isaac Pitman & Sons, Ltd., London. Price 22*s.* 6*d.*

This volume, in spite of the wide scope of its title, makes no claim to be a general treatise on the chemistry, properties, or technology of plastic substances. Although there is a real need for a book covering modern aspects of the production and fabrication of moulding powders and plastic articles, the present volume can only in part be considered as filling this gap. Mr. Simonds is concerned mainly with a very general description of the properties of the more common synthetic resins and American practice in their use. The general arrangement is, however, rather confused and insufficiently concise, and there is a great deal of repetition of material, notably in Chapters I, II, III, VI, and IX. The text is, moreover, rather marred by long and tedious lists of common articles, from ping-pong balls to starchless collars normally fabricated from the various synthetic resins, while the "slick" American prose makes odd reading to British ears in a technical work.

Chapters I and II dealing mainly with the classification of plastics and their basic raw materials are perhaps the least satisfactory, and the author overcomes the well-known difficulty of classifying these materials by merely quoting a number of rival systems, one of which is worthy of reproduction here:

"(1) Animal (casein), (2) vegetable (cellulose), (3) mineral (phenolics), (4) air (nitrates–ureas)."

Chapter III—"Ten Important Plastics"—deals reasonably adequately, but in very general terms, with the production and properties of the common synthetic resins, but no attempt is made to deal with chemical and physical properties in detail or with the production of the moulding powders in the chemical aspects.

The next five chapters cover a good general account of moulding, casting, and laminating technique and practice, including mould design and fabrication, but a more detailed discussion of injection moulding practice would here be advantageous. These chapters are copiously illustrated by excellent photographs of moulding equipment, etc., and of moulded plastics.

Chapter X deals all too briefly with the natural resins and waxes, rubber and the alky resins, whilst Chapter XI gives a very useful account of the fundamentals of the design of plastic articles.

Chapter XV attempts in very small compass to deal with the structural chemistry of the common synthetic resins and to distinguish between the properties of molecules with two- and three-dimensional linkages in terms presumably intelligible to the layman—here there are an undesirable number of errors in the formulæ.

While the author's enthusiasm makes excellent propaganda for the extended use of plastics, it is difficult to recommend this book to any specific class of reader. It should, however, prove useful to one desiring a *résumé* of the properties of synthetic resins in relation to methods of processing them, to the user and potential user of moulding powders desiring to appreciate the full range of products and methods now available, and perhaps to the student in conjunction with a more scientifically based text.

E. W. M. Fawcett.

This Fascinating Oil Business. By Max W. Ball. Pp. 444. Bobbs-Merrill Co., New York.

This book equally well deserves the adjective fascinating. It is well printed on good paper, of a convenient size, of reasonable price and good value for the money. The author is well qualified to write on the subject, having been associated with the industry in various capacities for thirty years. His experience with the U.S. Geological Survey, with the U.S. Bureau of Mines, and with two major oil companies, and his connection with scientific and technical societies have obviously given him a remarkable knowledge of all branches of the industry. This rather rare combination, together with an easy and attractive style, has enabled him to produce a remarkable book.

The book is offered "to eager-minded people as a journey of discovery." It will be equally pleasing and interesting to people who are engaged in one or more branches of the industry, who wish to have some knowledge of its other branches explained in a simple but accurate manner. A wise start is made by

some definitions and usages which are important, as many words in the oil jargon are used in special senses. The second chapter is unusual; it gives the reader short introductions to the oil-men, lease-men, pipe-liners, toolpushers, shooters, promoters, and salesmen. The chapter on oil geology is clear, up to date, and well illustrated by good diagrams. Geophysics is well handled and the information given re the latest methods is right up to date. This is followed by a most interesting chapter on "Acquiring the Right to Drill," unusual in a book which is mainly technical. Two chapters are devoted to drilling, including all the associated operations of acidizing, mudding, fishing, coring, and others. This chapter is well illustrated.

A concise chapter deals with the principles of producing, explaining water and gas pressures, gas–oil ratios, and decline curves, as well as proration and potential production. This is followed by one on the mechanics of this subject, which deals also with such problems as the life of a field, cost of production and mining oil sands, with special reference to Pechelbronn and Alberta.

The chapter on transportation deals well with pipe-lines and tank wagons, but dismisses the important subject of tankers with a picture and a few words.

The simple chemistry and physics of refining are treated clearly, but in an elementary way. The necessary points in specifications for various products are clearly explained, but the treatment is in some cases even too elementary, assuming that the reader knows nothing of elementary science. Only twenty pages are devoted to the refinery operations; the subject is, however, well condensed, and all the important operations are mentioned. "Most refineries have a pungent and pervasive odour that only refiners appreciate. If you would like to fill your lungs with unpolluted air suppose we take to the open road and watch the marketing of the products we have made."

The vastness of the distributing in comparison with the producing and refining industries is emphasized, but this is well condensed into the confines of one chapter. This chapter is very far from being a mere description of the methods of distributing, as it deals with such interesting subjects as prices, competition, service and sales efficiency, and the law of supply and demand.

The remaining third of the book deals with research and future possibilities; the historical development of the industry in the Old and New Worlds; and oil and the war. These chapters are well written, and contain a vast amount of interesting and accurate information, and provide very interesting reading.

The last chapter—"Oil and the War"—is necessarily now out of date.

The book is not written for oil-men, but for those who wish to get a clear and interesting picture of the industry as a whole. This picture is well presented in a brisk style. Most of the examples are taken from American practice. There are a few mistakes and inconsistencies, but they are not of importance. The official A.P.I. spelling of kerosine is not adopted. The view that oil is produced by slow distillation is not generally held, "aluminum" is hardly strange to English readers, but "busses" is. There are a few misprints, mainly in place names. The index is full and good.

The book is certainly worthy of a place in the libraries of all those who are engaged in any section of the industry and take an interest in others or in the industry as a whole.

J. KEWLEY.

Conversion of Petroleum. Production of Motor Fuels by Thermal and Catalytic Processes. By A. N. Sachanen, D.Sc. Pp. 413. Reinhold Publishing Corporation, 330 West Forty-Second Street, N.Y., 1940. Price 38*s*.

The scope of this comprehensive treatise can best be gauged by listing the headings of the chapters, which are as follows :—

Chapter 1 : Thermal and Catalytic Reactions of Hydrocarbons.
" 2 : Fundamental Factors of Cracking.
" 3 : Fundamental Factors of Hydrogenation.
" 4 : Cracking Equipment.
" 5 : Cracked Gasoline.
" 6 : Treatment of Cracked Gasolines.
" 7 : Cracked Products other than Gasoline.

As may be expected from one of the authors of *Chemistry and Technology of Cracking*, the subjects are very fully dealt with. Almost 400 references from published literature are given, many of them from articles published in 1939, so that the volume is clearly up to date, and no important aspect of the subjects has been neglected.

Interesting comments are made on the Houdry System of Cracking, but the main value of the book lies in the bringing together in one volume of such a large number of extracts from the literature which is so largely published by monthly journals.

A few errors caught the reviewer's eye, such as on page 241, where a heat transfer of " 15000 to 20000 B.T.U. per square inch " is clearly in error for that quantity per square foot.

The definition of " cracking " on page 103 appears to be unnecessarily rigid—*i.e.*, the treatment of petroleum products at temperatures higher than 400° C., for the decomposition of these bodies with aluminium chloride at 200–250° C. referred to on page 143 is undoubtedly a cracking reaction.

In Table 90, page 194, a definition is needed in the last column referring to yield, and the reviewer questions the soundness of the reasoning at the end of paragraph 3, page 246, regarding vapour locking of a hot oil pump.

The diagrams are mainly of good quality, and in most cases the description of the diagram is on the page facing it.

These criticisms are, however, minor when contrasted with the vast amount of information contained in the volume. W. N. HOYTE.

BOOKS RECEIVED.

Medical Manual of Chemical Warfare. 1939. Supplement. Arseniuretted Hydrogen Poisoning. Pp. 7. H.M. Stationery Office. Price 2*d.* net.

This pamphlet gives an account of the general properties and detection of arseniuretted hydrogen, together with a detailed description of the symptoms, pathology, and treatment of poisoning by this gas. The most characteristic feature of its action is the destruction of the red-blood corpuscles, with the consequent appearance of hæmoglobin in the urine and the development of jaundice and anæmia. The kidney and liver are also directly affected by the absorbed arsenic. Exposure for a few minutes to a high concentration of arseniuretted hydrogen may be rapidly fatal.

Transactions of the Institution of Chemical Engineers. Vol. 17, 1939. Pp. 201. Institution of Chemical Engineers, 56, Victoria Street, Westminster, London, S.W.1.

Among the ten papers presented before the Institution during the past year, the following may be mentioned as being of particular interest to the Petroleum Industry :

Problems of Compressors and Compressed Gases in Industry. (R. L. Quertier.)
Heat Transmission in Evaporative Condensers. (A. K. G. Thomson.)
The Theory of Gas Compression and Circulation. (Prof. D. M. Newitt.)
Some Aspects of Fundamental Research on the Corrosion of Metals. (W. H. J. Vernon.)

The Journal of the Iron and Steel Institute. Vol. CXLI, No. 1, 1940. Proceedings, xiv + 1 P–458 P; Abstracts and Bibliography, 1 A–321 A; Indexes, 1–61. Iron and Steel Institute, 4 Grosvenor Gardens, London.

This volume contains nine papers presented at the Annual General Meeting held in London on May 2nd and 3rd, 1940, together with discussions and correspondence on them. The volume, as in preceding years, is divided into two sections. Section 1 opens with the Minutes of Proceedings, including the speeches made at the Members'

Luncheon, the Report of Council and Statement of Accounts for 1939, and the papers enumerated above. Section II is devoted to a survey of literature on the manufacture and properties of iron and steel and kindred subjects.

Transactions of the Institute of Marine Engineers. Vol. 51. Session 1939–1940. Pp. 397. Published by the Institute, London.

Sixteen papers read before the Institute during the 1939–1940 Session are reproduced, including two on diesel installations, viz. :—

Some Recent Installations and their Characteristics. (C. C. Pounder.)
The Origin and Development of the Heavy-Oil Engine. (Akroyd Stuart.)

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Geology and Development.

1320.* Wildcat Drilling in 1939. F. H. Lahee. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 953–958.—Wildcat drilling was less intensive in 1939 than in 1938 and fewer pools were discovered.

From tables supplied in this review it is shown that during 1939 a total of 8,624,602 ft. was drilled in 2589 holes, making 270 producers and 2319 dry holes. Thus, 10·43% of the holes drilled and 12·87% of the footage were successful, the average depth of hole being 3331 ft. G. S. S.

1321.* Developments in Eastern Interior Basin, 1939 and First Quarter of 1940. A. H. Bell. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 959–969.—The Eastern Interior Basin occupies an area of approximately 49,000 sq. miles, of which 37,400 sq. miles (76%) are in Illinois, the remainder being in south-west Indiana and in Western Kentucky. The greater part of the recent oil activity in the basin has also been in Southern Illinois.

The paper briefly discusses recent developments, special reference being made to the new Devonian limestone production in Western Illinois. Five pools were discovered: Sandoval, Salem, Bartelso, Centralia, and Tonti.

The top of the Devonian Limestone is from 1100 to 1400 ft. below the McClosky oolitic limestone, and probably exceeds 2000 ft. in the deepest part of the basin.

All the new Devonian pools are in areas of structural closure as shown on either Pennsylvanian or Mississippian key beds or both; moreover, they are in areas of previous production from shallower sands. Initial production of these wells is exceptionally high for the area, exceeding in some cases 10,000 brl. per day.

G. S. S.

1322.* Deep-Sand Developments in Appalachian Region during 1939. T. H. Myers. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 970–973.—Developments for deep-sand oil and gas in the Appalachian region during 1939 had disappointing results. In Southern New York and Northern Pennsylvania each provided two new Oriskany gas-pools, but they all proved of very limited extent. Similarly, in Jackson Co. (West Virginia) two Oriskany pools were discovered, but neither has so far been tested sufficiently to give indication of its extent.

A map of the Appalachian area showing Oriskany development accompanies the paper. G. S. S.

1323.* Developments in Michigan during 1939. R. B. Newcombe. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 974–993.—During 1939 the leading fields in Michigan were: Bloomingdale (Van Buren Co.), Temple (Clare Co.), and Walker or Grand Rapids (Kent Co.).

The Bloomingdale field is the farthest south-west and the shallowest in depth of any size in South-western Michigan. It was the most actively drilled field in the State during the latter part of 1938 and the first half of 1939. Production is somewhat scattered and there are two non-productive saddles on the fold: Eastern Bloomingdale Township and along the Bloomingdale–Columbia Township line. Statistics of production are therefore given in three divisions: Bloomingdale, Columbia, and Mill Lake.

Temple field was discovered at about the same time as Bloomingdale, the major part of the producing area being in Redding. It is a "basin" field, production coming from a porous dolomitic zone just below the Bell Shale and considered to be of Monroe age.

The Grand Rapids field, although slow in developing early in the year, took on major proportions rapidly, and by June a boom was in progress. Production is from the Traverse at 1750–1900 ft. The limestone section in which porosity occurs is 30–50 ft. thick, but the actual pay section is much less. Large quantities of shallow gas have been found in the Berea (?) producing horizon at 1070–1100 ft., but no commercial use is made of the gas except for fuel in drilling. The Grand Rapids field has not been prospected beneath the Traverse on the top of the structure.

Other active fields in Michigan were Salem (Allegan Co.), Wise (Isabella Co.), Dundee or Deerfield (Monroe Co.), and the Wisner or Akron field in Tuscola Co.

Despite the discoveries, and increased activity in 1939, these did not keep pace with decline, and unless deeper production or new flush fields are found, it is considered that the outlook for 1940 is not particularly bright. G. S. S.

1324.* Developments in North Mid-Continent in 1939. E. A. Koester and R. F. Meyer. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 994–1010.—Drilling activity in Kansas decreased by about 14% compared with the previous year and by 48% below that for 1937. Initial oil production per well, however, increased from an average of 1208 brl. to 1577 brl. Norton and Phillips are new oil-producing counties, but in each area the discovery well is small and of doubtful economic importance. In Sherman Co. a gas discovery was made from the Cretaceous; this is of interest and importance, as this county was previously unproductive.

In Missouri forty-one wells were drilled in 1939, but, of these, eighteen did not reach Mississippian rocks. Twenty-three wells were drilled to horizons sufficiently deep to be considered "deep tests." Stratigraphically they include Pre-Cambrian (one), Arbuckle limestone (sixteen), Upper and Middle Ordovician (three), Devonian (two), and Mississippian (one). Results of drilling were definitely discouraging, but failure to produce, due to structural irregularities, should not be regarded as a true measure of the oil and gas possibilities of pre-Pennsylvanian rocks.

In Nebraska six important dry holes were completed, none of which is in the Forest City basin. The discovery of oil in the Pawnee Royalty Co.'s Boice No. 1, in Sec. 18, T. 1 N, R. 16 E, was probably the most encouraging development in Nebraska, although at present the well has not been successfully completed as a commercial producer.

Some drilling activity took place in the basin part of Iowa, but no completions were made. Wells in Charles Mix and Union Counties (South Dakota) were completed in Pre-Cambrian rocks, and supplied much valuable stratigraphical data.

G. S. S.

1325.* Developments in Oklahoma during 1939. E. F. Shea. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1011–1024.—Oklahoma in 1939 saw a slight increase in drilling operations, particularly in exploratory wells. New pools and extensions were thus added during the year, and showed an increase over the number recorded for 1938.

Little change occurred in the amount of geological and geophysical work carried out in the State, although exploratory operations were conducted in outlying areas away from producing pools.

Total production for the State during 1939 was 153,500,000 brl., a decrease of 16,500,000 brl., or 9·7%, on the previous year's total. Other than in the St. Louis–Maud area all the major producing pools were concerned in the general decline.

Of a total of 2065 completions, 268 (13%) are classified as exploratory wells. Sixty new discoveries were made; thirty-one pools and twenty-nine extensions to old pools. These are distributed over twenty-four counties: Seminole, with eleven areas, and Pottawatomie, with eight, predominating.

Stratigraphically they are distributed as follows: thirty-five in Pennsylvanian deposits, eleven in Siluro–Devonian, and fourteen in Ordovician. Despite the many discoveries of 1939, only three appear to be particularly noteworthy, viz. Hobart Pool (Kiowa Co.), Byars Pool (McClain Co.), and the Arbuckle production in the Frederick pool (Tillman Co.). G. S. S.

1326.* Will Illinois See Drastic Drop by Year's End? Anon. *Oil Wkly*, 22.7.40, **98** (7), 10.—Illinois' production is expected to decline, due to a fall in the Devonian output of Salem and to a fall in the Benoist, McClosky, Stein, and Aux Vases production throughout the State. The production history of the Devonian at Salem and Centralia is given in tabular form.

In general Devonian wells stop flowing in 1 to 3 months. At Centralia 72% of the Devonian wells are already on the pump.

At present there seems little hope of large discoveries. A 200-brl. well has been completed in the Trenton at Salem, and many Devonian wells could readily be deepened to this horizon. There is a possibility of Devonian development at Louden.

G. D. H.

1327.* Drilling Comparatively Brisk Despite Curtailment. L. J. Logan. *Oil Wkly*, 5.8.40, **98** (9), 10.—The July drilling was less intense than that of June, but greater than that of the corresponding period of last year. So far this year completions have been nearly at the 1937 level.

Tables give the total completions for the first seven months of the years 1933–1940, and the number of wells drilling in various States at the beginning of August as compared with the same date in 1939. The numbers of completions and their status are given in other tables.

G. D. H.

1328.* North-eastern Ohio Attracts Major Interest. S. W. Tait. *Oil Wkly*, 5.8.40, **98** (9), 32.—North-east and south-east from Cleveland some 200,000 acres of land have been leased, and two tests have been started in this region. Geophysical crews are at work.

The present gas-fields of Ohio are so depleted that they supply only a fraction of the domestic demand. There is a good knowledge of the geology as a result of the wells drilled during the past 80 years. The regional dip is south-east into the Appalachian geosyncline. Typical wells penetrate Mississippian, Devonian, and Silurian beds, which have oil and gas horizons. The possible producing horizons other than the shallow Big Injun are the Berea, Newbury, and Clinton. The Oriskany offers possibilities, but its occurrence is erratic. Ordovician tests in the Eastern fields offer little encouragement.

G. D. H.

1329.* Careful Exploration Required in North Dakota Oil Search. F. C. Foley. *Oil Gas J.*, 18.7.40, **39** (10), 14.—So far the search for oil and gas in North Dakota has yielded gas alone, and that in only one area.

Pre-Cambrian rocks do not outcrop in North Dakota, but are only a few hundred feet deep in the east. Palæozoic beds underlie all but the south-east corner, where Cretaceous rests directly on Pre-Cambrian. The Palæozoic thickens westwards to a maximum of about 6000 ft. Pre-Cretaceous Mesozoic is known which also thickens westwards. Lower Cretaceous beds are missing, but the Dakota occurs, followed by the Benton, Niobrara, and Pierre shales, calcareous beds and lenticular sandstones. Most of western North Dakota is underlain by Fort Union sands, clays, and lignites. Small patches of Oligocene are known.

The main structural feature is the Williston basin, a continuation of the Lemmon geosyncline of South Dakota. It may have a thickness of 12,000–14,000 ft. of sediments. Subsidiary structures may occur on the flanks of the Williston basin, but the surface evidence is not very satisfactory. The Cedar Creek anticline runs into south-western North Dakota, and has given gas. Geophysical work has been carried out in search of suitable structures for oil accumulation.

It is believed that oil in quantity may be confined to pre-Cretaceous beds, although the Cretaceous has shown oil and gas.

G. D. H.

1330.* Production Exceeds New Proven Reserves So Far This Year. W. V. Howard. *Oil Gas J.*, 25.7.40, **39** (11), 55.—During the first half of 1940 the U.S. proven reserves declined by 409,045,094 brl. Only Kansas and Mississippi found new reserves in excess of their production. It seems probable that many groups of small pools will be joined into single large pools, with a consequent increase in estimated reserves without much additional drilling.

A table shows the production, new discoveries, and extensions to old fields in terms of barrels. A second table gives the proven acreage, formation thickness, and estimated reserves for the new discoveries and extensions in the different States.

G. D. H.

1331.* World Crude Oil Production 6,000,000 Barrels Daily. H. S. Norman: *Oil Gas J.*, 25.7.40, **39** (11), 56.—During the first half of this year world crude-oil production attained a new peak. The main increases were in countries still at peace. World production rose by 7·6%, of which the U.S.A. contributed 6%.

Saudi Arabia's production rose by 119% to 1,180,000 brl., and Hungary's rose by 114%. Iraq's production has fallen by 50% since the middle of June.

The production in the first six months of 1939 and 1940 is tabulated for the different countries, and a map shows the locations of the main European and East Asiatic oil refineries, the capacities and cracking capacities of which are presented as totals for the various countries.

G. D. H.

1332.* Rincon Field of South Texas Being Steadily Extended. N. Williams. *Oil Gas J.*, 1.8.40, **39** (12), 13.—The producing area covers 1800 acres, and there are fourteen oil sands. This is probably only a quarter of the potentially productive area. Thirty-six oil and four gas-distillate wells have been drilled. Oil is obtained from nine sands at 3500–4300 ft., and gas-distillate from 4800 ft.

The structure appears to be a dome elongated north-east–south-west. It is 4–4½ ml. long and 3–3½ ml. wide. At the crest are 600–800 acres of gas and distillate production, whilst down dip oil is developed. The present development is mainly on the north-west and north, but some wells have been completed on the south-west of the structure. Each of the fourteen sands was carefully tested in a single well. All the sands are not found in every well, but most wells have more than one sand. The sands range in thickness from 10 to 60 ft. The first nine sands are in the Frio. Where several sands occur in one well they are produced successively from the bottom upwards.

The proved reserves are approximately 40,000,000 brl., and the wells are rated at 45–50 brl./day, according to depth. The average bottom-hole pressure is 1700 lb./in.^{2}. Two of the wells are on gas-lift; the rest flow.

The history of development is briefly outlined.

G. D. H.

1333.* Mississippi Entering Settled Exploration Stage. G. Weber. *Oil Gas J.*, 8.8.40, **39** (13), 22.—Since April there has been a drop in Mississippi drilling, and there has been a low degree of success in recent exploration. Many of the wildcats are deemed to have been poorly located and too shallow. Leasing and geophysical work have also declined.

Blanket sands occur in the Selma Chalk, Eutaw, and Tuscaloosa throughout a wide area. There are few outstanding structures like Jackson or Tinsley, but less pronounced structures have been shown geophysically—*e.g.*, the productive Pickens structure.

There has been much interest in the North-west Alabama basin, with its producing possibilities in the Palæozoic. Asphalt occurs in outcropping Mississippian beds. Geophysical work has been going on, and some wildcats are under way.

Southern Alabama has been sparsely drilled. It has gas shows in the upper beds. Two deep tests are to be extended through the Selma.

Tinsley has a recoverable reserve estimated at 24,000,000 brl. The main production is from the Woodruff sand at the base of the Selma Chalk. The sand thickens to the north-west, north, and east. Whilst the potential is 37,500 brl./day, the production averages 8000 brl./day. A major fault runs north-east–south-west through the field. There are productive possibilities in the underlying Eutaw, and this yields oil in the south-west where the Woodruff is missing. A sand between the Woodruff and the Stevens of the Eutaw also yields oil. Faulting makes subsurface correlation difficult.

Pickens has four producers, and it is thought that the present production is from the north-west flank of the structure.

G. D. H.

Drilling.

1334.* Drilling in United States. Anon. *Oil Gas J.*, 25.7.40, **39** (11), 76.—A statistical study of drilling in the various States of America is made. It is shown that an increase of 2586 in the number of wells completed in the U.S.A. during the first half of 1940 as compared with the same period of 1939 brought the total number of completions to 15,053—only sixty-nine below the number recorded for the record year of 1937. A. H. N.

1335.* Rock-bit Efficiency and Study of Tool-Joint Life. V. V. Horner. *Oil Gas J.*, 25.7.40, **39** (11), 171.—*Paper presented before American Petroleum Institute.*—After a detailed analysis of performance in the Louden field, it is concluded that drilling costs may be materially reduced if the following tactics are adopted in analysing the facts in hand.

For bit efficiency: (1) Detailed records should be maintained for individual wells regarding bit performance, such as footage/bit, hours on bottom/bit, and well average footages/bit and penetration. (2) To determine the proper type of bit for efficient operation, types of bits should be compared as used in numerical order. (3) The economic range of bit footage and penetration rate should be ascertained by establishing the relationship between the two and its effects on total cost, and with the choice of wells the averages of which fall within this range, optimum footage and rate for each separate bit in the sequence should be determined.

For tool-joints studies, periodic inspection with orderly compilation of data pertaining to outside-diameter wear and condition of tool-joint faces and threads can be utilized in providing comparative means of controlling tool-joint maintenance costs.

That this procedure is applicable in an area where stratigraphic characteristics are more or less regular and where activity is stimulated to the extent of providing initial data has been indicated by the results at Louden. A. H. N.

1336.* Application of Tapered Roller Bearings to Oil-field Uses. S. M. Weckstein. *Oil Gas J.*, 1.8.40, **39** (12), 38.—The importance of selecting the proper bearings for oil-field equipment where conditions of working are particularly strenuous is emphasized. The principles and mechanics involved in the design of a tapered roller bearing are briefly outlined and illustrated.

Typical tapered roller-bearing constructions are discussed, together with their respective advantages. These bearings are adaptable to carry all kinds of loads, radial, thrust, and all combinations of the two simultaneously. It is claimed that shafts run true and are kept permanently aligned.

The use of tapered roller bearings in reverse clutches, draw-works, and rotary tables is studied. In all cases, by replacing the sliding friction of plain bearings with smooth rolling friction less power is consumed in driving the machinery; dependable, trouble-free service is more nearly assured; and faster drilling is made possible, with lower maintenance and repair costs. A. H. N.

1337.* Rotary-Rig Foundations in Gulf Coast Marshes. N. Williams. *Oil Gas J.*, 8.8.40, **39** (13), 42–43.—Design and construction of foundations for rotary rigs operating on marshy locations are being given more study by Gulf Coast companies as depth of drilling increases, with consequent use of heavier equipment. Piling and mats are widely used, but are usually subject to uneven settling under excessive loads, or weakening by vibration. At a recently designed job in one Gulf Coast field the principles of construction employed gave greater strength, support, and rigidity to the piling foundations, thereby reducing the piling and bracing required. Thus costs of building were substantially reduced.

A plan and elevation of the newly designed piling foundation are included, as well as a discussion of the various aspects of design considerations to be taken in such an undertaking. A. H. N.

1338.* Combating Loss of Circulation in Drilling and Cementing. J. B. Stone. *Oil Gas J.*, 8.8.40, **39** (13), 44–45.—A new method of preventing fluid loss both in drilling

mud and cementing slurry circulation consists of using a flaky organic material, mixed in relatively small proportions in the cement slurry or mud. Its use is claimed to be particularly successful.

The material is a chemically inert product, fabricated into small, paper-thin flakes. It is not materially deteriorated or softened by water, oil, mud, or cement slurry. The plates are tough and strong even when wet. The flakes are specially treated to give them a crinkled surface, so that they will not adhere together when wet. The density of the material is similar to that of mud, so that they will not settle.

The dimensions are given as 0·001 in. thick, and in an irregular shape from $\frac{1}{4}$ to 1 in. in average length. The material passes easily through the pumps. As the flakes are flexible and pliant, however, they form a sheath or cover over the rough and irregular surface of a formation by being strained out of the circulating fluid.

Results of tests made on various materials are given. A. H. N.

1339.* Drilling Time Lost by Crooked Holes. T. P. Sanders. *Oil Gas J.*, 8.8.40, **39** (13), 55.—It is pointed out that in measuring deviations in a bore-hole the tests are usually made too far off the bottom. Thus in a case cited, when 2$\frac{1}{2}$° were measured, actual deviation of the well at bottom was 3$\frac{3}{4}$°. To avoid this difficulty it is recommended that: (1) If a float valve is used in the drill stem, it should be placed immediately above the drill collar, so that the instrument can be run as close to the bit as possible. (2) The deviation tests should be made immediately after adding a new joint, so that the bit will be practically on bottom at the time of test. (3) Tests should be made frequently, probably every 50–200 ft., depending on conditions. (4) The accuracy of the instrument and methods used should be sufficiently high to show deviations of 0·5° with certainty. A. H. N.

1340.* Squeeze Cementing Application and Technique. P. D. Torrey. *Oil Wkly*, 29.7.40, **98** (8), 68.—The conclusions reached from this fairly long paper are: Squeeze cementing in lime formations has recently shown good results, in great contrast to previous results. Excellent results have been obtained in West Texas fields in shutting off gas by the use of chemical plugging agents.

Smaller quantities of cement, when properly controlled, appear to be giving even better results than the larger batches formerly used.

The average percentage of success in squeeze cementing has definitely improved, and is now in the neighbourhood of 70% for all jobs. Some squeeze jobs have been attempted for the exclusion of water in essentially depleted reservoirs. The chances of success for such conditions are, however, remote.

The tendency for squeeze cementing before completion for reduction of gas/oil ratios is increasing, and is apparently giving better results than where squeezing is delayed.

It is believed that the speed with which large quantities of heavy cement slurry drop into the tubing with the circulation joint open causes a fluid-hammer effect which has been responsible for the collapse of casing. The substitution of smaller quantities of cement used in multiple-batch cementing may assist in correcting this difficulty.

Water exclusion in the East Texas field continues to be a problem. A relatively small number of wells still contribute the greater percentage of the water produced, and in view of the probable high degree of depletion of those areas more seriously affected by water, it is doubtful whether corrective measures under such conditions will prove to be profitable. A. H. N.

1341.* Drilling Activities. L. J. Logan. *Oil Wkly*, 5.8.40, **98** (9), 10–12.—Statistical data for drilling during July 1940 are presented and contrasted with corresponding periods of previous years. The paper deals with activity in the various States of the U.S.A. only. A. H. N.

1342.* Exact Measurement of Casing While Running into Hole. H. E. Gross and J. P. Hays. *Oil Wkly*, 5.8.40, **98** (9), 20.—In cases where casing measurement can be checked by independent methods—such as where the casing is landed on bottom of hole—the two independent figures for the depth should check to within 1 ft. in 4000 ft. It is reported that in a deep well where careful measurements were essential

duplicate measurements checked to 0·11 ft. in 10,700 ft., whilst 1 ft./10,000 ft. is not uncommon.

Methods for precise measurements of casing both in the racks and when being run into the well are described in exhaustive detail. The necessity of attention to every step in the procedure is emphasized. Troublesome items and pitfalls are stressed.

A procedure is also given for "juggling" pipe—*i.e.*, from the pipe at the top of a well, joints may be so selected or rejected as to total a predetermined length. An example is worked out to illustrate this procedure.

It is pointed out that a paper on depth measurement by means of multiple-strand wire lines appeared in *Oil Weekly*, 22.7.40; and one on drill-pipe and tubing measurements in the same *Journal* of 13th, 20th, and 27th June, 1938. These five papers describe all essential measurements involved in oil wells. A. H. N.

1343.* Oil-field Boilers. Anon. *Oil Wkly*, 19.8.40, **98** (11), 19–26.—The paper deals with trends in oil-field boiler design and use, and is illustrated by photographs of, and explanatory notes on, the main types of boilers commonly found in practice.

During the past few years boiler manufacturers have stepped up the rated working pressure of their top-line steam-generating units to a generally accepted high rating of 350 lb./sq. in., meanwhile holding the steam-generating unit within the limits of oil-field portability and overall dimensions. More recently working pressures of 500 lb./sq. in. have been utilized.

The steam dome, borrowed from locomotive-boiler practice where changes in speed and direction produced piling-up of the water, due to inertia forces, against one or the other tube sheets, seems to be disappearing from the oil-field unit.

Steam-liberating area is being increased. Foaming and other undesirable steaming characteristics increase in severity as steam-liberating area is restricted.

The controversy over superheat is apparently not yet settled. The two aspects of the question are discussed; both types of units are available—*i.e.*, with and without a superheater.

Various aspects of boiler design are also reviewed. A. H. N.

1344.* Light-Weight Drilling Equipment. H. L. Flood. *Petrol. Engr*, August 1940, **11** (12), 27–28.—Drilling practice in Illinois is specially studied. More important than any other factor as an influence on the manner in which drilling is conducted in Illinois and on the type of equipment used is the matter of shallow depths. Thus far 2000–3000 ft. are the average depths to which most of the wells have been drilled.

The drilling equipment in use in these areas is predominately of the light-weight, easily moved type generally classified as slim-hole or streamlined equipment. Many can be winched on a truck and readily moved as one piece. Equally important are the truck-mounted portable masts and drilling machinery generally classed as being of the core-drilling type.

Several entirely new designs in spudders recently introduced by various manufacturers are now being extensively used in the Illinois fields.

The general practice is to drill down with rotary equipment to the top of the producing formation, set and cement casing, move out the rotary equipment, and then move in a spudder to drill out the plug and complete the well. A. H. N.

1345.* High-Pressure Salt-water Flow in Drilling Operations. M. L. Cashion. *Petrol. Engr*, August 1940, **11** (12), 90.—When a drilling well encounters high-pressure salt-water flows it usually means the abandonment of the operation if only orthodox methods are employed in an endeavour to combat such flows. In an area on the Gulf Coast twenty tests have had to be abandoned because of inability to cope with the salt-water flow always encountered under excessive pressure at depths of about 10,000 ft. The paper describes the procedure of combating this danger employed in a well recently successfully drilled to 12,000 ft. in the same area.

The success of the operations was probably due to the fact that preparations were made for every possible contingency, and it is now decided that in future operations none of the apparently too numerous precautions taken will be eliminated.

The two chief items of interest, however, were the pressure-drilling technique used and the mud treatment. Relatively few innovations were employed. The pressure-

drilling equipment and technique were directed towards constantly maintaining a back-pressure on the salt formation. The mud treatment prevented excessive flocculation of the colloid under the influence of the salt water.

Details of both these items are fully given. The pressure equipment included: (1) hydraulic feed rotary, including snubbing equipment; (2) pressure-control equipment on the well-head; (3) chokes on the mud return lines; (4) back-pressure valves, etc., in the drilling string; and (5) external-flush drill pipe, to permit going in and out of the hole through the drilling packer under pressure. Each item is discussed separately.

In the mud used, silicate of soda was included as an ingredient to counteract the effects of high-pressure salt-water flows. Furthermore, the liquid phase weighed 11·8 lb./gal., against 8·33 lb./gal. in the case of ordinary water muds. The extra weight in the liquid phase allows fabrication of high-weight muds with a much lower suspended-solids content than is ordinarily needed. Various other advantages of this silicate mud are discussed.

The paper deals further with the technique and other incidental equipment used, which nevertheless is believed to have been essential to the success of the project.

A. H. N.

1346. Drilling Patents. C. D. Barnes. U.S.P. 2,209,591, 30.7.40. Appl. 20.1.36. Well-drilling fluid containing starch and an aliphatic alcohol, besides the heavy solids suspension characterized by low penetration and low gas-cutting properties.

C. E. Wilcox. U.S.P. 2,209,619, 30.7.40. Appl. 3.9.37. Cable-tool drill-bit having a pilot cutter of smaller diameter than the intended hole and a reamer eccentrically disposed to the vertical axis.

C. C. Matlock. U.S.P. 2,209,988, 6.8.40. Appl. 4.3.39. Pipe tongs.

B. Hanly. U.S.P. 2,210,077, 6.8.40. Appl. 12.10.39. Drill-bit cone-cutter bearing arrangement.

T. H. Stancliff. U.S.P. 2,210,101, 6.8.40. Appl. 30.1.39. Drilling bit for rotary rigs.

O. Duda. U.S.P. 2,210,202, 6.8.40. Appl. 26.2.38. Travelling block construction.

A. C. Catland. U.S.P. 2,210,279, 6.8.40. Appl. 18.2.38. Rock bit with cutters on horizontal ball bearings.

C. L. Henry. U.S.P. 2,210,407, 6.8.40. Appl. 2.9.38. Portable derrick, being hinged at one end so that it may be lowered horizontally for transport, and the upper sections adapted to be telescoped to shorten overall length.

C. L. Henry. U.S.P. 2,210,408, 6.8.40. Appl. 8.9.38. Marine-working platform structure initially supported on a floating barge, but arranged to be finally supported on firm bottom by means of towers and removing barge away from structure.

C. M. O'Leary. U.S.P. 2,210,464, 6.8.40. Appl. 20.9.37. Means for taking side-wall cores having in combination a surveying instrument for recording direction and inclination of hole simultaneously with coring.

R. T. Cloud. U.S.P. 2,210,795, 6.8.40. Appl. 16.2.39. Method and apparatus for electrically logging a bore-hole.

S. A. Linney. U.S.P. 2,210,815, 6.8.40. Appl. 23.1.39. Tool-joint pin.

B. F. Walker. U.S.P. 2,210,824, 6.8.40. Appl. 27.12.38. Rotary drilling tool for scraping the walls.

J. H. Williams. U.S.P. 2,210,826, 6.8.40. Appl. 19.4.39. Fluid packing for a swivel.

H. Deckard. U.S.P. 2,210,902, 13.8.40. Appl. 28.6.38. Fishing tool.

G. Krell. U.S.P. 2,211,016, 13.8.40. Appl. 14.9.38. Elevator for supporting pipe, possessing a special hinge mechanism having horizontal and vertical hinging axes.

J. J. Jakosky. U.S.P. 2,211,124, 13.8.40. Appl. 11.3.39. Method for continuously exploring bore-holes while drilling by using the drilling string as an electrode, and measuring resistance of earth to a D.C. at various distances from bore-hole for each depth reached, and repeating operations at various depths.

E. J. Shaffer. U.S.P. 2,211,173, 13.8.40. Appl. 6.6.38. Pipe coupling, being a tool-joint arranged so that the box exerts a compressive stress on the pin; a welded ring made to avoid localized stresses.

A. L. Stone. U.S.P. 2,211,178, 13.8.40. Appl. 21.8.37. Method of making a joint-box on end of pipe.

A. L. Stone. U.S.P. 2,211,179, 13.8.40. Appl. 12.11.38. Casing joint for casings of equal inner diameter, one end of pipe being belled to receive the spigot end of the other.

J. A. Tytus and A. L. Stone. U.S.P. 2,211,183, 13.8.40. Appl. 12.9.38. Reamer for well pipe-joints.

M. B. Chittick and A. F. Schlandt. U.S.P. 2,211,254, 13.8.40. Appl. 3.2.37. Wire rope lubricant consisting of viscous mineral oil, fibrous material, and from 3 to 20% hydrocarbon polymers which oxidize to tough dry coatings on contact with air.

W. G. L. Smith. U.S.P. 2,211,299, 13.8.40. Appl. 4.1.37. Wire-cable guide.

A. N. Troshkin. U.S.P. 2,211,466, 13.8.40. Appl. 28.7.39. Hose coupling.

R. E. Lilleberg. U.S.P. 2,211,507, 13.8.40. Appl. 23.11.38. Self-adjusting pipe wrench.

H. T. Byck, J. W. Freeland, and H. C. Lawton. U.S.P. 2,211,688, 13.8.40. Appl. 12.7.39. Method of treating oil and gas wells, during drilling, with a fluid of water-soluble alginate, an alkali hydroxide, and a water-soluble organic material of weakly acidic properties and an alkali pyro- and meta-phosphate.

C. R. Irons. U.S.P. 2,211,696, 13.8.40. Appl. 23.9.37. Treatment of wells for the removal of mud-sheaths electrically.

W. A. Warburton. U.S.P. 2,211,803, 20.8.40. Appl. 7.8.39. Method and equipment for multiple whipstock drilling and lining.

C. Gauthier. U.S.P. 2,211,973, 20.8.40. Appl. 22.9.39. Fishing tool of the pin-tap type.

M. H. Joseph. U.S.P. 2,211,978, 20.8.40. Appl. 5.12.38. Hose coupling.

B. E. Parrish. U.S.P. 2,212,040, 20.8.40. Appl. 28.5.38. Oil-saver with a bore the size of which is reducible.

J. E. Hoffoss. U.S.P. 2,212,067, 20.8.40. Appl. 20.3.39. Drilling apparatus consisting of a drill-bit and a guide, the guide having a reaming tool incorporated in it.

C. W. Thornhill. U.S.P. 2,212,086, 20.8.40. Appl. 27.10.36. Float-collar and guide-shoe.

C. W. Thornhill. U.S.P. 2,212,087, 20.8.40. Appl. 27.11.39. Well-cementing apparatus utilizing the guide-shoe of U.S.P. 2,212,086.

V. B. Zacher. U.S.P. 2,212,108, 20.8.40. Appl. 23.4.38. Process for treating mud consisting of clay, water, and lignin. A. H. N.

Production.

1347.* Distillate Fields Bring New Production Phase. B. Mills. *Oil Wkly*, 29.7.40, **98** (8), 53.—A review is made of the theory and practice of distillate production involving retrograde vaporization and gasoline extraction and recycling of dry gas.

Retrograde condensation is the change of gas to a liquid state following a reduction of pressure. Pressure maintenance in a reservoir of gases in the retrograde pressure regions becomes necessary. A substantial reduction in formation pressure is usually accompanied by a sharp loss of fluid that could otherwise have been recovered as gas under the original reservoir pressure. Conversely, it may be possible, by increasing the formation pressure, to force into the vapour phase certain heavier products that were originally in the reservoir in the liquid state. A case is cited where this process has probably occurred.

The nature of diffusion of the injected gas with the wet gas already in place is not fully known, but it is believed that some mixing does occur. A few practical fieldmen believe that dilution or mixing is extensive, but it is known that proper spacing of injection wells will force the wet gas to the producing wells with a minimum of dilution.

Various plants are described. A. H. N.

1348.* Gas Lift Becomes Major Producing Method. Anon. *Oil Wkly*, 29.7.40, **98** (8), 62.—The trend of gas-lift installations appears to be towards wider application of differential type units in holes where thorough study indicates a wide variation in anticipated flow rates of the well, and where wide range of water content may be expected.

Intermittent lifts with either clock, pressure, or combined surface controls find a place in the same field as automatic intermitter, and fit particularly well into a lease wherein close regulation of the flow within stated limits must be maintained. For this type of production, with increasing water content, exchange of the master timing unit enables the intermitting frequency to be varied as conditions change.

Where ample gas volumes are available, either the plunger lift or the pneumatic flow-chamber may be used, although in both cases the time interval required between cycles may intervene to prevent either from handling the requisite volume of fluid from a well making a high percentage of water. A. H. N.

1349.* Deep Well Pumping. Anon. *Oil Wkly*, 29.7.40, **98** (8), 89.—This paper represents the views of many contributors on two questions put to them by the *Oil Weekly* regarding the best method of artificially lifting oil from 10,000-ft. or deeper wells. A summary of the answers is as follows: (1) A general inclination to leave the solution of the problem until it arises. (2) Fairly general agreement that all available means should be utilized to extend the proportionate quantity recovered by natural flow, and thus at least delay the necessity of artificially lifting oil from such depths. (3) Because most deep wells may be expected to maintain a high fluid level in the well after natural flow ceases, it will rarely be necessary to lift oil from depths actually exceeding present lowest pumping levels. Therefore current pumping methods may be used. (4) Should it become necessary to lift from the bottom of 10,000—13,000-ft. hole, the majority of engineers at present think in general terms of some bottom-hole pump actuated by liquid pressure applied from the surface, by means of gas lift, standard pumping, electric centrifugal bottom-hole pumps or a combination of gas-lift with bottom-hole units. A. H. N.

1350.* Modern Equipment Keeps Lifting Costs Low. E. Sterrett. *Oil Wkly*, 29.7.40, **98** (8), 96.—Typical of the trend towards smaller and cheaper pumping units is the entry of the pumping-unit type of machine into the light or stripper well fields of 5-h.p. loads, the adoption of metal-to-metal pumps in the medium- and low-price fields, and the use of hydraulic pumps in small-capacity wells. Other improvements in well-servicing equipment built for safe and rapid work are discussed.

Large units are further described and their advantages enumerated. Details are given of the units mentioned in the first paragraph. Improvements discussed in the

case of centrifugal submerged pumps are the glass insulation for motor windings, flat cable conductors, and the use of corrosion-resistant parts, all adapted with a view to lengthening the normal life of the unit.

Cushions for rod-strings are of three types: (1) those incorporating resilient solids such as springs or rubber; (2) those using compressibility of air or gas; and (3) those using controlled fluid flow under pressure to regulate the relative motion between linked parts.

Methods of combating rod corrosion and sand form the conclusion. A. H. N.

1351.* Technical Advancements and Economics of Water-Floods. L. M. Arnold and R. C. Earlougher. *Oil Wkly*, 29.7.40, **98** (8), 105.—The basic fundamentals of water-flooding having been established, the problem now is how to use the method economically. It is found to be cheaper in the long run to use siliceous lime-water than river-water. This is due to the variation both in quantity and quality of river-water, necessitating continuous watching and checking. Once a process of treating siliceous lime-water is set up it may be considered to be stable and relatively automatic. The chief drawback in using this water is its relatively high corrosiveness. This difficulty is being overcome by using cement-lined pipes.

The water-to-oil ratio averages 10 : 1, being between 5 : 1 and 18 : 1 in various projects.

Another operating method which is being used in Mid-Continent area is to flow the oil from the wells rather than pump it. This is accomplished by using higher water pressures, and results in low initial investment, due to absence of pumping units. Discussions are still in progress as to which is the better method: flowing or pumping.

A strong plea is made for wide well spacing from an economical point of view, and a short discussion is given on the economics involved in spacing programmes.

A. H. N.

1352.* Distillate Fields Bring New Production Phase. Part II. B. Mills. *Oil Wkly*, 5.8.40, **98** (9), 13–19.—Recycling methods involve the adaptation of methods falling into one of the following classifications: separation, refrigeration-separation, and absorption. Descriptions are given of recycling plants employing the straight separation method. The principle of all such plants is to run the gas into one or more separators in series, reducing the pressure and recovering the liquid distillate.

Flowsheets, photographs, and pertinent data accompany the descriptions of plants used in Stratton field, Long Lake, and Bammel field, all in Texas.

In the last-mentioned plant gas from wells is run through chokes and meters to two high-pressure separators, the lean gas from which is scrubbed in a tower, compressed, and reinjected into an input well. The bottoms from the high-pressure separators are passed through intermediate and low-pressure separators and finally stored, the lean gas from these last separators being used as fuel. A. H. N.

1353.* Mobile Pump House for Flood Project. F. B. Taylor. *Oil Wkly*, 12.8.40, **98** (10), 17–18.—In a flooding project using river-water it was found that the river could obtain a stage variation of 40 ft. To obviate possible damages from shutdowns, the problem of protecting the water-supply system at all times was solved by mounting the pump-house on an inclined track and rendering the pump mobile.

A description is given of the construction and operation of the unit. A. H. N.

1354.* Distillate Fields Bring New Production Phase. Part III. B. Mills. *Oil Wkly*, 12.8.40, **98** (10), 19–28.—In this part of the series of articles on recycling, descriptions are given of plants using temperature reduction for extracting liquids from distillate production, and commonly called refrigeration-separation systems.

Flow-sheets, photographs, and pertinent data accompany the descriptions of the several plants. The process in one of these may be summarized: Gas passes through a cooler and into a scrubber, from the top of which it goes into a dehydrator, where it meets a calcium-chloride solution cooled by an ammonia refrigeration plant, after which it passes on to high- and low-pressure separators in series. The lean gas passes from the top of the separators through heat exchangers and into compressors, to be injected back into the formation whilst the condensate is taken from the bottom

of the separators. The calcium-chloride circuit is continuous, taking the solution from concentrators, pumping it through the refrigeration plant and into the dehydrator, where it meets the gas from the scrubber and, after dehydrating it, passes through horizontal separators and back into the concentrate tank. A. H. N.

1355.* Exact Technique for Shooting Wells. Anon. *Oil Wkly*, 12.8.40, **98** (10), 30.—Shooting in the Illinois Basin whenever output declines to uneconomical levels has become common practice and an exact technique has been developed.

The first step is to remove the pumping unit and clean the hole by means of a small portable drilling machine. A shot is lowered and set according to accepted practice. A bridge is placed immediately above the time-bomb and the hole is tamped.

Two tamping methods are in common use: the "pea-gravel" tamp, and the other involving the use of quick-setting cement. These two methods are detailed. The force of the explosion is expended horizontally into the formation, and not upwards injuring the casing. The top of the casing is left open in both cases.

Clean-out methods are described for removing the debris from the bottom of the well. Ordinarily the time taken for preconditioning the well, cleaning out, and replacing the tubing and rods is 7 days. A. H. N.

1356.* Removing Paraffin from Pipe and Sand Face with Carbide. F. R. Cozzens. *Oil Wkly*, 19.8.40, **98** (11), 25.—The treatment of the sand face with carbide consists of removing the tubing and rods, bailing the hole as dry as possible, and then filling with water. A nipple or section of pipe about 8 ft. long, open at the top, with a slot cut in the side, is screwed into the casing-head to permit the escape of carbide fumes above the worker's head.

Carbide, in ¼ × 1-in. pieces, is rapidly dumped down the casing through the slot in the fume-pipe, 100 lb. carbide/brl. of water in the reservoir. The heat of reaction between water and carbide is sufficient to raise the temperature of the water to 100–125° F. After the well has stood for an hour, the fume-nipple is removed and the shot-hole bailed out while the residue, which contains the melted paraffin, is still hot.

The action of the carbide also results in caving of the sand-body, and when the accumulation is removed a fresh sand-face is provided in the well. A. H. N.

1357.* Distillate Fields Bring New Production Phase. Part IV. B. Mills. *Oil Wkly*, 19.8.40, **98** (11), 28.—Recycling plants are considered an economic necessity in distillate fields if (1) gas wastage is to be avoided by returning unmarketable stripped residue to the producing formation, and (2) reservoir pressure is to be maintained so as to prevent the occurrence of retrograde condensation and subsequent loss of recoverable contents.

Of the several types of recycling plants, this paper discusses some of those operating on the absorption principles. An interesting development in the adaptation of the absorption method in recycling operations has been the remarkable increases found feasible in absorption pressures. Whereas a short time ago it was not considered desirable to attempt absorption at pressures greater than 800–900 lb./sq. in., modern recycling plants are operating at pressures up to 1500 lb./sq. in., and tests indicate that absorption pressures in excess of 2000 lb./sq. in. are practical.

Typical absorption-type recycling plants are illustrated and discussed individually, together with details of dimensions, capacities, and characteristics. A. H. N.

1358.* Butane Used as Penetrant in Acidizing Kansas Completion. Anon. *Oil Wkly*, 19.8.40, **98** (11), 46.—A production test on a newly drilled well showed that the well yielded 28 brl. in 2 hr. The crude was heavy, 20° gravity A.P.I. Study of the problem indicated that the crude was of such a consistency that it might insulate the acid from the formation; it was consequently decided to use a diluent, in order to reduce the viscosity of the crude immediately near the sand face.

A compounded method was applied in stages. As a first step an acid gun cleaned the sand face with an acid jet. Compounded pumps then forced butane into the sand through a tubing string, the annulus between tubing and casing being filled with water. Finally, acid was forced into the formation.

The results obtained were satisfactory, although the effects of the butane cannot be individually assessed. A. H. N.

1359.* Practical Advantages of Small Area Pressure Maintenance. Anon. *Oil Wkly*, 26.8.40, **98** (12), 18–22.—After development was substantially complete, operators owning all but a small amount of extreme-edge leases formed a unit to operate the Wilcox sand production of the pool. This made it possible to initiate careful reservoir control and to take advantage of a pronounced and efficient water drive. The sand has zones of varying permeability, and in order to prevent an uneven water encroachment and to prolong the flowing life of the wells, the rate of withdrawal was voluntarily reduced and pressure maintenance instituted.

The bottom-hole pressure has been maintained within 93% of its original status, although 7½ million barrels of oil have been produced. The decline has been practically eliminated in recent months, indicating a long flowing life for the field. Although the field covers scarcely more than 1 sq. mile and was substantially developed when unit operation was inaugurated, scientific exploration is estimated to have effected a saving of $500,000 by the elimination of unneeded wells and prolongation of flowing life. It is further predicted that proper utilization of reservoir energy will reduce operating costs by an estimated $1,500,000. The lifting cost has been only a fraction more than 3 cents/brl.

Details of the operations and practices are given. A. H. N.

1360.* Distillate Fields Bring New Production Phase. Part 5. B. Mills. *Oil Wkly*, 26.8.40, **98** (12), 26.—This forms the concluding part of the symposium on recycling operations, and continues the discussion of absorption-type distillate recycling plants commenced in Part 4. It is a description of a series of typical plants, giving photographic illustration and individual details of the dimensions, capacities, and characteristics of each. A. H. N.

1361.* Gas and Oil Separation in Deep Fields of California. W. A. Sawdon. *Petrol. Engr*, August 1940, **11** (12), 42.—In general, two methods are employed: two-stage separation at the well, and divided separation with high-stage separation at the well and low-stage separation at a central station. Both methods are described and illustrated.

Except for a new trap in which tests have recently been completed, the high-pressure separators have been capable of handling production at the rate of 1500 brl./day. The new type can handle 2500 brl./day.

Gas from each separator, the high- and low-pressure, is measured by orifice meters, and the recent practice has been to place the orifice flange on the vertical gas line leading downward from the top of the separator. This eliminates the collection of condensate at and around the orifice and has been found to be a very satisfactory arrangement.

Where the second method is used, the oil arriving at the central station from the well passes through a low-pressure separator, where the remainder of the gas is removed. This gas is then recompressed and enters the absorber with the high-pressure gas. At low production rates 80% of the gas is separated under high pressures. A. H. N.

1362.* Deepening and Completing a Well in the Lisbon Field, Louisiana. Part 7. P. D. Torrey and F. H. Miller. *Petrol. Engr*, August 1940, **11** (12), 63.—This paper gives further details of production tests and analysis of the crude oil.

A discussion is given on the estimation of oil and gas reserves in a new field as illustrated by the typical case under study. Three types of estimates are made, the method of calculation being presented in a table. The first estimate presupposes using pressure maintenance, gasoline extraction, and optimum separation pressures. The second estimate differs from the first in using 2000 lb./sq. in. at 65° F. for separation. The third method does not include a gasoline plant, but is otherwise similar to the second.

Finally, a table gives estimated recoveries and gross value of production from different well-spacing units for each of the three methods. The units for well spacing are 160-acre, 320-acre, and 640-acre, respectively. Under all three methods of production the total gross value of gas and condensate was a maximum for the 640-acre spacing. Of the three methods, the first yielded the highest value. A. H. N.

1363.* Proper Sealing of Abandoned Wells Important in Mining Areas. F. R. Cozzens. *Petrol. Engr*, August 1940, **11** (12), 104.—The importance of proper sealing of abandoned wells so that gas cannot travel through porous formations into a coal seam, and hence to the mines and be a source of dangerous explosions, is emphasized.

One device generally used is a tapered plug of wood, driven into the sand, and backed-up with cement slurry. This method is effective if sufficient loose material falls on top of the cement to close the cavities which form in the walls as the casing is lifted. Otherwise gas pressure increases, and over a course of years becomes sufficient to force openings around the weakened cement seal. Closing the hole at the surface tends only to increase the pressure below ground.

It has been found that a filler of residue placed over a plug is more vital to a permanent seal than the type of plug used. The filler must be resilient enough to fill cavities, yet solid enough to pack into a continuous gas-proof mass. Silt or fine pulverized dry clay is suitable.

Even more effective is the procedure of mixing the silt or the fine clay with coarse salt in a ratio of 1 lb. salt to 10 lb. silt. The mixture is dumped dry, and no water is used. Moisture is drawn from the walls, and the pack settles quickly and effectively. A. H. N.

1364.* First Six Months' Production (in U.S.A.). W. V. Howard. *Oil Gas J.*, 25.7.40, **39** (11), 78–79.—Crude-oil production for the first six months of 1940 was 684,733,094 brl. This represents 11·1% increase over the first half of 1939 and an increase of 10·6% over the corresponding period of the peak year of 1937. Average daily production of 3,762,270 brl. is 56·5% greater than 1933, and by far the greatest part of this increase is due to a rise in domestic demands. Of the nation's supply, 58·8% or 404,400,039 brl. came from seventy-five fields, of which East Texas produced 71,856,874 brl. A. H. N.

1365.* Cotton Valley Agreement Offers Complete Pressure Maintenance. G. Weber. *Oil Gas J.*, 25.7.40, **39** (11), 168.—Oil operators and landowners of the Cotton Valley field have unitized all their holdings in that field to set the stage for the beginning of the largest unitized recycling project ever undertaken. This agreement establishes a precedent and furnishes an example for the formulation of similar, much-needed instruments in other condensate fields. The paper discusses the significance of the terms of major importance in the agreement. A. H. N.

1366.* Less Heat, More Chemical May Increase Profits. T. P. Sanders. *Oil Gas J.*, 25.7.40, **39** (11), 174.—Many oil companies, in accounting treating costs, do not place sufficient emphasis on losses in oil gravity resulting from breaking the emulsion, but give much prominence to expenditure for treating chemicals. Oftentimes a study will reveal that an overall saving may be effected by the use of more chemicals and less heat, or by proper arrangement of lease batteries. A. H. N.

1367.* Systematic Study of Reservoirs for Efficient Pool Operation. T. P. Sanders. *Oil Gas J.*, 1.8.40, **39** (12), 30–32.—Most oil companies were originally organized with a rather sharp division between producing and geological departments. While results show that such a form of organization has been eminently successful, in many instances it has been found that this limits the use of practical geology and geological records in solving producing problems. For overcoming this objection several different forms of organization have proved successful.

One such organization is undertaken by a pool-study department within the producing department. It is the duty of this group to combine all geologic and production data in order to present a coherent picture of the reservoir as it exists at various stages during its productive life.

The data required for a pool-study is tabulated as: (1) Elevation. (2) Log: casing; depth of showings; water encountered; top of producing horizon; penetration; bottom of producing horizon; shot or acid record; total depth. (3) Initial shut-in casing pressure. (4) Initial production or potential for both oil and gas. (5) Fluid levels, static, oil and water. (6) Continuous record of production of oil, gas, and

water. Gas–oil ratio and water % from periodic tests. (7) Complete operating history, showing plug-backs, reperforating, shooting, acidizing, giving dates, depths, and production before and after.

For new pool-studies the following additiona records are recommended: (1) Electric log. (2) Core description. (3) Core analysis. (4) Bottom-hole pressures: (*a*) as early as possible after discovery; (*b*) at regular monthly intervals. (5) Bottom-hole fluid samples, initially and also later. (6) Productivity tests. A. H. N.

1368.* Economical Pumping of Wells. T. P. Sanders. *Oil Gas J.*, 15.8.40, **39** (14), 48.—In the field under study it was predicted that pumping would prove uneconomical at the 6500 ft. depth due to sand troubles, gas lock, and water encroachment. Almost all the wells, however, are now pumped economically, and many of them for a small daily production. The practices adopted and servicing methods used are described in detail.

Sand troubles are overcome by using screens and prepacked gravel liners. The characteristics of the gravel packs are given. Another method adopted is the use of a "sand anchor"—a sand screen which somewhat resembles a gas anchor. Metal-to-metal pumps are used, but in one place a plunger is fitted with combination rubber and fabric rings mounted in machined grooves and dipped in kerosene in order to cause it to expand and fit snugly in the barrel. The ends of the plunger never emerge from the barrel during pumping.

To combat rod abrasion by the sand, rod rotators are installed on the beam, thus distributing the wear over the surface of the rod. The rods are suspended from a swivel, and a wire line hitched on to the walking beam operates a ratchet on a notched disc, thereby turning the rods several degrees. A. H. N.

1369.* 2,930 Ft. of Welded Casing Run in Well in Seven Hours. H. F. Simons. *Oil Gas J.*, 15.8.40, **39** (14), 61.—Dimensional details of the casing joints used are given. Time of running casing is reduced by 33·3% by using long joints, thus reducing the number of welds.

One of the savings resulting from using this type of running casing is due to the fact that only two welders are needed in addition to the regularly employed crew, instead of three men to help the regular crew in ordinary jobs. The welded casing requires neither spinning up nor tonging, and hence the regular crew can perform all the work but the welding.

After the weld is finished, it has to be left to cool for a minimum of 45 secs. before lowering it into the hole. This procedure allows the weld to cool to a temperature below the critical point. Lowering the pipe into the hole sooner than this would result in its being prematurely quenched in the drilling mud, thereby weakening the structure of the welded portion and making failure possible. Average time to run a joint of the casing is 4½ min., including time for picking up the joint, inserting it, welding and lowering the casing ready to pick up the next joint. A. H. N.

1370.* Intermittent Gas Lift Beneficial to Large Wells. T. P. Sanders. *Oil Gas J.*, 15.8.40, **39** (14), 63.—It is pointed out that intermittent gas lift is capable of reducing the gas–fluid ratio on almost any well which produces less than 1000 brl./day of fluid.

This very short paper is based on the data presented by E. C. Babson before the American Petroleum Institute. (Cf. abstracts Nos. 263, 265, 267, and 271.)

1371.* Production at the Oilfield El Trebol. F. R. Ruiz. *Bol. Inform. Petroleras*, April 1940, XVII (188), 33–42.—A gradual fall of pressure in this oilfield called for special measures in order to maintain satisfactory output. The article describes in detail, with curves, the decline in pressure, deals with the pumping in of gas, methods of drying the latter, its solubility in the petroleum, etc., and gives tables of pressures and quantities. Apparently production was unduly forced in some of the wells, owing to too optimistic expectations. H. I. L.

1372. Patents on Production. De M. G. Miller. U.S.P. 2,209,466, 30.7.40. Appl. 13.12.38. Seal indicator for pumps of the deep-well turbine-pumps type.

T. V. Moore. U.S.P. 2,209,534, 30.7.40. Appl. 6.10.37. Method for producing gas wells by adisbatic or polytropic expansion of the high-pressure gas into a chamber and repassing the cooled low-pressure gas through a heat exchanger to cool the high-pressure gas to its dew point and separating the liquid.

L. C. Miller. U.S.P. 2,209,627, 30.7.40. Appl. 27.3.39. Well device and operating means therefor, for closing a well utilizing fluid pressure.

C. P. Walker. U.S.P. 2,209,944, 30.7.40. Appl. 7.9.37. Method of measuring location of obstructions in deep wells by means of the echo recordings of a pressure wave generated in the annulus between the tubing and casing.

E. F. Raymond and L. Spencer. U.S.P. 2,210,125, 6.8.40. Appl. 1.11.37. Gun perforator for well casings, consisting of a wire-rope connection, loosening jar structure to give hammering blows, and a firing mechanism.

G. F. Turechek. U.S.P. 2,210,192, 6.8.40. Appl. 13.3.39. Gun-perforator socket for receiving bullet and explosive charge.

R. D. Elliott. U.S.P. 2,210,205, 6.8.40. Appl. 30.3.39. Water-intrusion location in oil wells characterized by injecting an oxidizing agent into the region under test and measuring polarization effects by means of an electrode. Agent becomes diluted by incoming fluid.

N. R. Kimmel. U.S.P. 2,210,245, 6.8.40. Appl. 27.9.38. Formation tester.

R. R. Kyner. U.S.P. 2,210,247, 6.8.40. Appl. 13.11.37. Gas-lift apparatus.

M. O. Boulter. U.S.P. 2,210,359, 6.8.40. Appl. 12.9.39. Well-tubing paraffin remover, the tool being driven hydraulically downwards.

M. M. Kinley. U.S.P. 2,210,417, 6.8.40. Appl. 1.11.37. Leak detector by altering height of fluid in casing and picking up sound generated by flow of liquid, the intensity being an indicator of depth of leak.

A. C. Hamilton, Jr. U.S.P. 2,210,545, 6.8.40. Appl. 15.11.39. Process of sealing openings in the earth.

K. Grosse and G. Schlicht. U.S.P. 2,210,582, 6.8.40. Appl. 12.9.38. Method for the extraction of petroleum by mining operations after degassing the formations through a vertical shaft, by using horizontal and inclined drift network system.

C. C. Christian. U.S.P. 2,210,885, 13.8.40. Appl. 30.4.36. Well construction using perforated casing.

A. Hollander. U.S.P. 2,210,977, 13.8.40. Appl. 8.12.37. Strainer for submersible motor pumps adapted to be connected between motor and pump.

J. W. MacClatchie. U.S.P. 2,210,983, 13.8.40. Appl. 13.4.37. Method and means for perforating well-casing in place by means of a gun fitted with a safety mechanism, which gun is lowered on a cable and can be fired at a number of points.

J. W. MacClatchie. U.S.P. 2,210,984, 13.8.40. Appl. 23.12.38. Means for perforating well-casing consisting of a gun with a multiple cartridge magazine and multiple firing mechanism.

J. H. Howard. U.S.P. 2,211,122, 13.8.40. Appl. 10.3.38. Tubing head and hanger with a multiplicity of sealing means.

J. M. Pearson. U.S.P. 2,211,158, 13.8.40. Appl. 13.9.38. Method for orienting cores using magnetic properties.

J. H. Howard. U.S.P. 2,211,206, 13.8.40. Appl. 13.3.37. Method and apparatus for completing a well where it is required to run a screen into a high-pressure well having a casing closed near its upper end.

G. W. Haury. U.S.P. 2,211,776, 20.8.40. Appl. 2.8.37. Resilient coupling for tubing and method for making the same.

C. C. Brown. U.S.P. 2,211,845, 20.8.40. Appl. 9.11.33. Means for equipping wells under pressure.

C. C. Brown. U.S.P. 2,211,846, 20.8.40. Appl. 26.11.37. Valve of the sleeve type in a tubing.

C. R. Athy. U.S.P. 2,211,965, 20.8.40. Appl. 9.11.36. Chain mechanism for connecting pump-rods with walking beams.

C. W. Parris. U.S.P. 2,211,983, 20.8.40. Appl. 4.11.37. High-pressure joint for tubes and the like.

H. C. Otis. U.S.P. 2,212,036, 20.8.40. Appl. 3.4.37. Union for well-heads in combination with an oil-saver.

R. M. Ridley. U.S.P. 2,212,044, 20.8.40. Appl. 24.7.39. Method and apparatus for perforating well-casings.

R. M. Ridley. U.S.P. 2,212,045. 20.8.40. Appl. 24.7.39. Gun perforator.

J. F. Eaton and H. D. Collins. U.S.P. 2,212,153, 20.8.40. Appl. 10.2.38. Vibration damper to be incorporated in sucker-rod strings.

A. L. Parker. U.S.P. 2,212,183, 20.8.40. Appl. 2.3.38. Tube coupling.

W. N. Eddins. U.S.P. 2,212,416, 20.8.40. Appl. 21.2.38. Fluid-operated pump for deep wells.

A. H. N.

Natural Gas.

1373.* Gas Dehumidification Prevents Hydrate Freezing Troubles. E. G. Hammerschmidt. *Nat. Petrol. News*, 15.5.40, **32** (20), R. 162.—Various methods of eliminating hydrate freezing troubles in natural gas and natural gasoline plants are discussed. In general all the methods remove water condensate and sufficient water vapour from the system so that further condensation cannot occur either under conditions of minimum temperature or maximum pressure. Seven gas-washing solutions are described. These include calcium chloride, diethylene glycol, and lithium chloride. The last-named has been used only on air-conditioning plants, but since it offers many advantages over $CaCl_2$ its extended use is to be expected. Glycerine is sometimes used in conjunction with $CaCl_2$. Solid adsorbants simplify plant design owing to their smaller relative volume. Silica gel, activated alumina, anhydrous calcium sulphate, and bauxite impregnated with manganous chloride are all in successful use.

H. G.

1374.* Manufacture of *iso*Butane at Kettleman Absorption Plant. L. P. Stockman. *Oil Gas J.*, 15.8.40, **39** (14), 50.—A description is given of a recently modernized Kettleman Hills gasoline-absorption plant, originally designed to handle 107 million cu. ft. of gas, and to produce 125,000 gal. per day of finished gasoline, and now modified to produce *iso*butane. The original stabilizer column has been converted into a depropanizer, and new debutanizer and de*iso*butanizer columns have been added. A propane refrigeration unit operating under automatic pressure control maintains temperature conditions on the absorption oil and wet gas. Positive cooling for the propane condensate and reflux is provided by a simple unit forced-draft cooling-tower operating in conjunction with the atmospheric tower. An increased production of 6% of gasoline has resulted, in addition to yields of other hydrocarbons, in a relatively pure state. Simplified control, reduction of fluctuation, and enhanced value of the gas have also resulted. *n*-Butane of purity $\pm$ 98% and *iso*butane of purity 96–98% containing 2–2½% of *n*-butane and a trace of propane are produced.

A flow-sheet and operating data of the plant are presented. C. L. G.

Cracking.

1375.* Houdry Units' Heat-Transfer Salts Described at A.I.C.E. Meeting. Anon. *Nat. Petrol. News*, 12.6.40, **32** (24), R. 220. (*Abstract of paper read by W. E. Kirst, W. M. Thayle, and J. B. Castner vide A.I.C.E. Transactions, Vol.* 36, *No.* 3, *June* 1940.)—Molten salts consisting of 40% $NaNO_2$, 7% $NaNO_3$, and 53% KNO_3 are used on a large scale on Houdry cracking units. They possess a low melting point, high heat-transfer rate, and adequate thermal stability, and are applicable at a higher temperature than any other commercial heat-transfer medium without recourse to elevated pressure. Corrosion problems are claimed to be not great. Open-hearth steel may be used up to temperatures of 850° F. High-chromium and certain low-chromium–aluminium–silicon steels are recommended for temperatures up to 1100° F. H. G.

Hydrogenation.

1376. Reactions of the Catalytic High Pressure Hydrogenation of Coal and Oil and Their Control. M. Pier. *Trans. Faraday Soc.*, 1939, **35**, 967–979.—An account is given of the main principles of high-pressure hydrogenation. Two processes are general; liquid-phase treatment with low catalyst concentration, and vapour-phase hydrogenation with high catalyst concentration. Sometimes necessary also are a refining process to remove O_2, S and N, and an ash-removal process. Temperatures are usually below 400° C., although in a few cases high anti-knock petrols can be obtained at 500° C. Recycling of products is universal.

An analysis of various starting materials and catalysts is given, together with the anti-knock values of the petrols obtained. The author concludes that by this process all types of hydrocarbon oils, from high-quality aviation spirits to lubricating oils, can be obtained by suitable choice of raw materials and catalyst. M. McL.

1377. Patent on Hydrogenation. G. W. Johnson. E.P. 524,380, 6.8.40. Appl. 8.4.38. Catalytic conversion of hydrocarbons containing more than 15 gm. of hydrogen to 100 gm. of carbon by subjecting to cracking or hydrogenation under pressure and in the presence of an initially highly active catalyst, but the activity of which has been reduced by treatment of substances poor in hydrogen. H. B. M.

Polymerization.

1378.* Sohio Polymerization Unit First Using New Catalyst. M. G. Van Voorhis. *Nat. Petrol. News*, 26.6.40, **32** (26), R. 230.—Copper pyrophosphate is the catalyst used in the plant described. The feed, from high-pressure stabilizers, contains 32·4% unsaturates which suffer 80% conversion into 84 O.N. polymer gasoline. At least 95% of the product boils below 400° F. and it is all blended into motor fuel. The catalyst is not recovered, but is discarded when spent. H. G.

1379. Patents on Polymerization. Universal Oil Products Company. E.P. 524,986, 20.8.40. Appl. 10.1.39. Treatment of hydrocarbon mixtures containing 3 or 4 carbon atom olefins and derived from the cracking of petroleum oils to render them suitable for catalytic polymerization without deleterious effects on the catalysts employed. The olefin-containing mixture is washed in liquid phase with water for the removal of basic impurities and with aqueous alkali for the removal of acidic impurities.

The Distillers Co., Ltd. E.P. 525,276, 26.8.40. Appl. 16.2.39. Depolymerization of polystyrene by subjecting it either in pure or crude form to rapid heating of short duration, the speed of which is ensured by intimately contacting the polystyrene with the body or surface of a heated material of high heat conductivity at a temperature between 550° and 700° C. H. B. M.

Alkylation.

1380.* Neohexane Plant Operating at Record High Pressures. R. C. Alden. *Nat. Petrol. News*, 26.6.40, **32** (26), R. 234.—A large-scale plant for the production of neohexane from ethylene and *iso*butane is described. *iso*Butane at 4500 lb./sq. in. is pumped through an alkylation coil at 950° F. Controlled quantities of a mixture of ethylene and *iso*butane are admitted to the coil at several points. The products are neohexane and high-octane-number gasoline, the latter containing appreciable quantities of *iso*pentane resulting from the interaction of ethylene and propane. The boiling point of neohexane is sufficiently different from those of the hydrocarbons occurring with it to ensure its removal, by fractionation, in a reasonably pure state. Since neohexane is a pure hydrocarbon, the commercial product has a more constant octane number than that of commercial *iso*-octane, which is usually a mixture of 2 : 2-dimethylbutane and 2 : 2 : 4-trimethylpentane. The high octane number, high lead susceptibility, and high volatility of neohexane will overcome the volatility obstacle to the development of aviation fuels with octane ratings above 100. In addition to neohexane, the plant described offers facilities for the large-scale manufacture of *iso*-pentane by separation from *iso*-octane and for the preparation of straight-run gasoline and natural gasoline. A range of gasolines of octane number up to 115 is therefore available. H. G.

1381.* Alkylation Plant takes Olefins left by Selective Polymerization. A. H. Garrison. *Nat. Petrol. News*, 12.6.40, **32** (24), R. 212.—An outstanding development of the past year in the utilization of light petroleum fractions to produce high-grade aviation fuels has been the rapid expansion of the sulphuric-acid alkylation process. In the plant described the charging stock consists of the residual butane–butene fraction from hot acid polymerization. Substantially all the olefinic portion of the charge consists of the normal butenes remaining in the residual C. 4's after the removal of all the *iso*butene and dienes and part of the normal butenes by the hot-acid process. Alkylation is carried out at 40–60° F. with 96–100% H_2SO_4. The major heat load is carried by exhaust steam, and refrigeration is by means of an ammonia absorption-type unit. No very unusual control problems arise except in the de-*iso*butanizer column, which operates at a 20° temperature differential from top to bottom. Acid consumption is at the rate of 0·55–0·6 lb. per gal. of alkylate. The product has a Reid vapour pressure of 2·5 lb. and contains 0·001% S. Its end-point is 375° F., with 90% recovery at 255° F. H. G.

Synthetic Products.

1382. Petroleum Synthesis can Supply Rubber in National Emergency. J. Farquar. *World Petrol.*, August 1940, **11** (8), 64.—The development, production, and properties of synthetic rubber, particularly of the Buna type, are discussed, and reference is made to the possibility of supplying the entire U.S. requirements with synthetic rubber manufactured from petroleum. The U.S. consumes 600,000 tons of rubber per annum (60% of the world's rubber supply), importing this from Ceylon and the East Indies. Up to six months' supply is available in storage, but in the event of emergency it would be possible to complete sufficient industrial plants to make synthetic rubber, at a cost of perhaps $100,000,000. Production of neoprene and thiokol amounts to 1750 tons per annum, but is expected to increase to 4000 tons per annum by the end of the year. German production of Buna rubber from coal provides half their requirements, and this is expected to increase to three-quarters. A plant is being constructed at Baton Rouge to produce 5 tons of synthetic rubber per day, at a cost of $1,000,000–$1,250,000, by the end of 1940.

Synthetic rubber in Germany consists of Buna S from butadiene and styrene and Buna N (or Perbunan) from butadiene and acrylo-nitrile. The former has a greater resistance to abrasion than natural rubber, and the latter, in addition, is superior in resistance to deterioration in heat, and oil, and in ageing qualities. Perbunan Extra (Buna NN) is a copolymer of butadiene with a higher percentage of acrylo-nitrile. The greater toughness of synthetic rubber over natural rubber is attributed to the cross

linkages in the molecule formed during polymerization, whereas the rubber molecule consists largely of straight-chain polymers. This is particularly the case with the Buna S, but less so in the case of the butadiene–acrylo-nitrile polymers which are formed in an emulsion. This cross bridging results in some difficulty in mastication on the rubber mill, so that it is necessary to add softeners. Less sulphur is, however, required for vulcanization. Perbunan tends to harden on heating, becoming stiffer on ageing.

The improved resistance to swelling in oil and other solvents is believed to result from the presence of the nitrile groups in the polymer. The low tensile strength of the pure Perbunan (800 lb./sq. in.) is greatly increased by the addition of 40–50% of channel black (to 4000–5000 lb. per sq. in.). A similar proportional increase in the strength of pure rubber (3500 lb. per sq. in.) on reinforcing would yield a remarkable structural material, so that research along these lines is indicated.

Perbunan is expected to be produced at a cost of \$0·20 to \$0·30, comparing favourably with neoprene at \$0·75 per lb. and approaching the minimum price of rubber—\$0·10 per lb.

Graphical data on the swelling and tensile strength of Perbunan as compared with rubber after immersion in various solvents, and the effect on the tensile strength of Perbunan after the addition of gas-black, are presented. C. L. G.

1383. Patents on Synthetic Products. Armour & Co. E.P. 525,184, 22.8.40. Appl. 17.2.39. Preparation of condensation products by reacting acetylene or an acetylene hydrocarbon with phosgene in the absence of free oxygen.

Les Usines de Melle. E.P. 525,198, 23.8.40. Appl. 15.2.39. Preparation of di-olefines by the catalytic dehydration of the corresponding glycols, olefinic alcohols, or mixtures of these compounds. Volatile phosphorous-containing compounds are used as catalysts. H. B. M.

Refining and Refinery Plant.

1384.* Desulphurization of Ishimbaevo Gasoline with Hypochlorite. B. A. Englin, *Neft. Khoz.*, 1939, No. 8, 36.—It has been found that gasolines from Ishimbaevo crude, which do not contain hydrogen sulphide, can be desulphurized under refinery conditions by acidification with hypochlorite to an acid reaction. Under suitable conditions of treatment and right commencement of acidification a considerable improvement is achieved. If 1·5% (4%) hypochlorite, taken as dry calcium hypochlorite, is added, a gasoline is obtained which, after redistillation with 95% yield, contains 0·155% (0·105%) sulphur and 0·017% (0·025%) chlorine, respectively. With higher percentages of hypochlorite, sulphur can be entirely eliminated.

The treatment is as follows: gasoline from the rectifying column flows into the mixing condensers, where the hydrogen sulphide and lower mercaptans are removed by alkali wash. Thereupon the gasoline is treated with hypochlorite in two stages. First it is mixed with alkaline hypochlorite to a negative doctor test. During the whole of the following process $\frac{1}{4}$–1*N*-sulphuric acid is added. The hypochlorite consumption is in the first stage 1·6–2% and in the second 1·8–2·2%, that of the sulphuric acid 0·04–0·06% and 0·1–0·13%, respectively. The second batch of hypochlorite is added after decantation of the first. When the hypochlorite treatment is finished, the gasoline is washed with water and redistilled with alkali. A 2·5% alkali–gasoline solution is supplied into the still, where it is mixed with superheated steam of 200–250° C. The gasoline yield is 97–98%. As an emergency, distillation may be carried out without alkali, but the output will then be only 95%, with a subsequent alkali and water wash. L. R.

1385.* Italians Process Albanian Heavy Oil to Aviation Gasoline. E. A. Bell. *Oil Wkly*, 22.7.40, **98** (7), 28.—In 1868 an oil zone was discovered north-east of Valona, and the development which followed gave an annual crude output which averaged 6000 tons before 1914. After the war several companies took up concessions, but finally all the areas came under Italian control. Very satisfactory results have been obtained in the Devoli region, and early in 1939 there were 250 wells giving oil from depths of 1640–2620 ft.

The oil is asphaltic and gives 12–18% of gasoline. On cracking it may give a maximum of 40% of gasoline, and on hydrogenation it can give 80% of gasoline of high octane number. The hydrogenation is carried out at Bari and Livorno. Each plant has a capacity of 120,000 tons/year of 100-octane gasoline and 30,000 tons of high-grade lubricating oil. There are other products. These plants can also be used for the hydrogenation of lignite and bituminous shales.

Italy imports the bulk of her oil requirements, and in 1938 her crude oil production, never very large, had fallen to 13,000 tons. G. D. H.

1386.* Gasoline Treating Patents Issued One Weekly in 1939. Anon. *Nat. Petrol. News*, 15.5.40, **32** (20), R. 179.—Brief details are recorded of the relevant patents under four headings: (*a*) Sweetening processes, (*b*) gum stabilization processes, (*c*) anti-knock improvement processes, (*d*) miscellaneous processes. H. G.

1387.* Specification of Materials for Refineries. A. Bertoni. *Bol. Inform. Petroleras*, April 1940, XVII (188), 43–53.—This article discusses the methods adopted in specifying pipes, valves, and accessories required in refinery work. Schedules are given for seventeen different classes of material classified according to the purpose for which they are to be used. The author refers to the I.R.A.M., which lays down the qualities of materials to be used in every case, and he suggests that it would be advantageous if an official Materials Testing Institute could be set up, particularly in view of the war, when certain standard materials may be unobtainable and substitutes would have to be carefully tested. H. I. L.

1388. Patents on Refining. Standard Oil Development Corp. E.P. 523,894, 25.7.40. Appl. 14.10.38. Separation of olefins having 2–5 carbon atoms from mixtures of the same with saturated hydrocarbons. The olefins are absorbed in sulphuric acid and regenerated from the acid liquor. The acid employed is stronger than that normally used, and the acid liquor obtained is heated without dilution in the form of a thin film to a temperature higher than the boiling point of the alcohols that may be formed from the acid liquor.

A. E. Rheineck. U.S.P. 2,210,305, 6.8.40. Appl. 22.11.38. Process for treating an oil from the group consisting of oiticica oil and po-yoak oil to render the oil suitable for use in varnishes, etc. The oil is acetylated until it has the property of drying in a relatively short time and of forming a smooth, glossy film.

R. C. Palmer and C. H. Bibb. U.S.P. 2,211,432. Appl. 19.8.38. Treatment of monocyclic terpene hydrocarbons by heating to reaction temperatures in the liquid phase in the presence of a catalyst containing effective amounts of both copper and nickel in an active form to effect substantially complete conversion of the hydrocarbons into *p*-cymene and *p*-menthane.

Deutsche Erdol, A.-G. E.P. 524,587, 9.8.40. Appl. 1.2.39. Raffination of mineral oils and tars by means of liquids containing phenols. The treatment is effected in steps, the phenol content of the liquid used in a subsequent step being higher than that of the liquid employed in a previous step. H. B. M.

Safety Precautions.

1389.* Prevention of Accidents in the Y.P.F. B. Rikles and R. Galletti. *Bol. Inform. Petroleras*, April 1940, XVII (188), 64–79.—This very fully detailed paper was originally written for the Argentine National Committee of the World Power Conference, and was intended for presentation at the Second Chemical Engineering Congress which was to have met in Berlin in June of this year. The paper should be of considerable interest to those concerned with safety regulations in works generally as apart from oilfields and refineries in particular. H. I. L.

Chemistry and Physics of Petroleum.

1390. Activation of Hydrogen in Catalytic Reactions of Hydrocarbons. A. Farkas. *Trans. Faraday Soc.*, 1939, **35**, 906–917.—The author discusses the formation of hydrocarbon bonds by the activation of hydrogen by metal catalysts. It is shown that hydrogen atoms are formed on the catalyst surface; methods of measurement of the rate of formation are discussed. A possible mechanism for the reactions at high and low temperatures is suggested, and its correlation with practical results investigated. M. McL.

1391. Catalytic Exchange of Hydrogen Atoms between Molecular Deuterium and *n*-Hexane and *cyclo*Hexane. A. Farkas and L. Farkas. *Trans. Faraday Soc.*, 1939, **35**, 917–920.—These exchange reactions are shown to follow a similar mechanism to that proposed for ethylene and benzene (*Trans. Faraday Soc.*, 1937, **33**, 82), involving the formation of hydrogen atoms on the surface of the catalyst. A new mechanism is suggested for the dehydrogenation of *cyclo*hexane. M. McL.

1392. Fundamentals in the Catalytic Ring Closure of Open-Chain Hydrocarbons. H. S. Taylor and J. Turkevitch. *Trans. Faraday Soc.*, 1939, **35**, 921–934.—A general review is made of the thermodynamic and practical problems involved in the large-scale production of aromatics from open-chain hydrocarbons. The use of various catalysts has been investigated, together with the optimum conditions of temperature and pressure; it is found that for paraffin hydrocarbons, long contact time, high temperature, and oxide catalysts, such as Cr_2O_3, are most effective.

The effects of oxygen and water-producing substances in poisoning the catalysts are noted, together with the best methods of conversion of olefines into ring structures. M. McL.

1393. Mechanism of Catalytic Exchange Reactions between Deuterium and Olefines. G. H. Twigg. *Trans. Faraday Soc.*, 1939, **35**, 934–945.—The two possible mechanisms of this interchange are discussed, and experimental work on heavy ethylene, C_2D_4, is described, which indicates that an associative rather than a dissociative mechanism is operative.

Data are given also of energies of activation, of exchange, and of hydrogenation for ethylene, propylene, butene-2, and *iso*butene over the range 55–120° C. M. McL.

1394. Fischer–Tropsch Synthesis of Hydrocarbons, and Some Related Reactions. S. R. Craxford. *Trans. Faraday Soc.*, 1939, **35**, 946–958.—This paper describes a comprehensive investigation into the Fischer–Tropsch synthesis of hydrocarbons as regards optimum conditions and the mechanism of the catalysed reaction. In all cases the standard catalyst, cobalt–thoria–kieselguhr, was used; best results were obtained at medium pressures and in the temperature range 175–225° C.

It is concluded that the mechanism involves the formation of a cobalt carbide Co_2C by a dual process. This carbide is then reduced by hydrogen to give chemisorbed methylene groups, which in turn build up to hydrocarbon chains.

Experimental work included the use of the *ortho-para*-hydrogen conversion as an indication for the reaction, and is described in some detail.

Notes are also made of the condition where the Fischer–Tropsch synthesis fails, forming methane rather than hydrocarbon chains; a suggested explanation is given. The effects of the presence of ethylene are also discussed. M. McL.

1395. Experiments on the Fischer–Tropsch Synthesis of Hydrocarbon from Carbon Monoxide and Hydrogen. E. F. G. Herington and L. A. Woodward. *Trans. Faraday Soc.*, 1939, **35**, 958–967.—The double effect of the Fischer–Tropsch synthesis, in giving either oil and water, or methane and water, has been investigated. The latter effect is found to be due to high-temperature effects on the catalyst, either by insufficient initial cooling or too rapid subsequent heating. The methane production is also promoted by a high H_2/CO ratio in the ingoing gas.

A "running-in" process for the catalyst is described, which ensures the production of oil.

Further effects are described as follows: the use of hydrogen at synthesis temperature on a used catalyst, causing immediate revivification of the latter and the complete poisoning of the catalyst by excess H_2S or CS_2 at 200° C. A suggested explanation of the former effect is given. M. McL.

1396. Mechanism of Catalytic Dehydrogenation and Cyclization. R. C. Pitkethly and H. Steiner. *Trans. Faraday Soc.*, 1939, **35**, 979–984.—Investigating the mechanism of ring formation by cyclization of paraffins, the authors, using *n*-heptane, have obtained heptene and toluene. No *cyclo*-paraffins, *cyclo*-olefines, nor di- or tri-olefines were to be detected. Experiments were made to show whether the heptene was a by-product or an intermediate in the reaction. Measurement of equilibrium partial pressures indicated that it was an intermediate—a fact supported by thermodynamical reasoning. Two possible mechanisms of the reaction are discussed. M. McL.

1397. Destructive Hydrogenation and Destruction of Hexadecane. H. I. Waterman and J. J. Leendertse. *Trans. Faraday Soc.*, 1939, **35**, 985–992.—The destructive hydrogenation and cracking of hexadecane at 435° C. for 1 hr. using nickel–kieselguhr and chromium oxide catalysts have been studied.

Destructive hydrogenation gave practically no products of molecular weight higher than that of the starting material, indicating an almost complete absence of side-reactions. The products were normal or nearly normal paraffins.

Cracking in the presence of nitrogen gave cyclic and branched hydrocarbon products, including appreciable quantities of hydrocarbons of higher molecular weight than hexadecane; indicating the occurrence of polymerization of primary unsaturated reaction products. M. McL.

1398. Investigation with the Cyclization (Aromatization) of Aliphatic Hydrocarbons. H. Hoog, J. Verheus, and F. J. Zuiderweg. *Trans. Faraday Soc.*, 1939, **35**, 993–1012.—In this investigation many aliphatic hydrocarbons were passed over Cr_2O_3 catalyst at 465° C., atmospheric pressure and 17 ml./hr./55 gm. catalyst rate of flow. Yields and compositions of products were determined.

The main conclusions were: hydrocarbons the structure of which permits of direct formation of a 6-membered ring will be cyclized to a marked extent, others will not. Side reactions are shown by individual groups; thus paraffins are dehydrogenated to aliphatic mono-olefines, aliphatic olefines are either hydrogenated to paraffins or undergo a shift of the double bond, *cyclo*-olefines are hydrogenated to naphthenes, naphthenes show no side reactions.

Paraffins, and olefines with 8 C-atoms, show some cracking reactions. The degree of aromatization increases in the order paraffins, aliphatic olefines, 6-ring naphthenes, 6-ring *cyclo*-olefines, for corresponding compounds.

Suggestions are given for the mechanisms involved. M. McL.

1399. Some Problems Associated with Olefine *iso*Paraffin Addition Reaction. S. F. Birch and A. E. Dunstan. *Trans. Faraday Soc.*, 1939, **35**, 1013–1021.—These authors discuss the addition of olefines to paraffins to give higher paraffins, in the presence of sulphuric acid at low temperature. The products are a complex mixture of *iso*-paraffins b.pt.'s 27–185° C., together with a small olefinic residue. It is shown that the action of the acid is not purely catalytic, a highly unsaturated oil being recoverable by dilution of used acid.

A mechanism is suggested of proton addition from acid to olefine, followed by action between the activated olefine, and an acid paraffin polar complex. The *iso*paraffins would then be formed by a series of side reactions. M. McL.

1400. Heavy Metal Sulphides as Catalysts for the Polymerization of Olefine Hydrocarbons. E. K. Ingold and A. Wasserman. *Trans. Faraday Soc.*, 1939, **35**, 1022–1024.—The use of heavy metal sulphides as catalysts in the polymerization of simple olefines was investigated. It was found that the white and yellow sulphides were

inactive, but that the black sulphides, particularly cupric sulphide, were more effective. The most effective agent was found to be cupric sulphide which had been allowed to stand in the air until 30% cupric sulphate had been formed. The sulphide had to be prepared from $CuSO_4 + H_2S$ in acid solution.

A suggested mechanism for this catalysis in the case of the polymerization of β-butylene is given. M. McL.

1401. Dimerization Reactions of Unsaturated Hydrocarbons. E. Bergmann. *Trans. Faraday Soc.*, 1939, **35**, 1025–1034.—This is a general review of the nature of dimerization as applied to various heights of unsaturated hydrocarbons. Two main types of dimerization occur: "Dimerization proper," with formation of *cyclo*butane derivatives, an action which only occurs by irradiation, and "migratory" dimerization with formation of a new olefine caused by migration of a hydrogen atom. This latter alone can be considered as the elementary stage of polymerization. Reviewing the experimental work, the author finds that for mono-olefines and dienes the mechanism of polymerization cannot be made to correspond at all with that of "migratory" dimerization; so that no general rules can be laid down for these classes. For acetylenes and for triphenylallene "migratory" dimerization can be satisfactorily applied, although in the latter case it is followed by *cyclo*-isomerization of the acylated allene derivatives. M. McL.

1402. Low-Molecular Polymerization of Dienes and Trienes. E. H. Farmer. *Trans. Faraday Soc.*, 1939, **35**, 1034–1040.—This deals with the polymerization of conjugated and unconjugated di- and tri-enes. It is found in general that two forms of polymer occur: linear polymers of large molecular weight and low molecular series of early polymers from dimers up to hexamers. In the present work the latter type alone are studied and many alternative mechanisms are suggested, of which, owing to the complexity of structure involved, no one can be considered more satisfactory than another. M. McL.

1403. Dimerization of Petroleum Hydrocarbons. W. J. Sparks, R. Rosen, and P. K. Frolich. *Trans. Faraday Soc.*, 1939, **35**, 1040–1054.—Starting from a description of the commercial dimerization of *iso*butene to obtain commercial *iso*-octane, the authors develop a theory of dimerization involving the shift from one monomer to another of a hydrogen atom which finally appears in the dimer on the previously unsaturated C-atom which adjoins the newly formed bond. This shift may occur through free valencies or through a prototropic change.

Other dimerization reactions are discussed, notably those of olefines, di-olefines, and acetylene, and it is shown that the proposed shift is, in general, not at variance with the apparent mechanisms involved. M. McL.

1404. Preparation and some Physical Properties of 2 : 2 : 4 : 4-Tetramethylpentane. F. L. Howard. *Bur. Stand. J. Res.* (*Wash.*), 1940, **24** (6), 677–684.—The method of Whitmore and Southgate was used, and consists in reacting dimethyl zinc with 2 : 2 : 4-trimethyl-4-chloropentane. The latter was prepared by the action of HCl on "di*iso*butylene," whilst the zinc dimethyl was made by reacting methyl iodide with zinc copper alloy.

The crude 2 : 2 : 4 : 4-tetramethylpentane was purified and then distilled. The physical constants determined on the purest fraction included freezing point, boiling point, and its variation with pressure, refractive index, and density, and their variations with temperature. D. L. S.

Analysis and Testing.

1405.* Determination of Naphthalene in Coal Tar and its Products. W. Kirby. *J. Soc. chem. Ind.*, 1940, **59**, 168–171.—The method is based on the fact that the addition of tar oil to naphthalene lowers the setting point by an amount depending on the quantity of oil added.

The determination of naphthalene in coal-tar naphtha is given as an example :—

The residue left on distilling 100 gm. of naphtha to 197° C. was 7·5 gm. A portion of this residue weighing 4·992 gm. was added to 14·630 gm. of pure naphthalene. The mixture was melted, and its setting point was found to be 70·8° C., corresponding with 83% of naphthalene. A simple calculation shows that the naphthalene originally present in the naphtha was 2·4%. Normally it is preferable to stop the distillation for a naphthalene residue at 190° C.

Curves and tables are presented giving the percentage naphthalene in coal-tar products according to setting point, in quantities ranging from 30% to 100% naphthalene. T. C. G. T.

1406.* Determination of the Composition of Commercial *iso*Pentane. K. H. Hachmuth and J. W. Tooke. *Nat. Petrol. News*, 1.5.40, **32** (18), R. 142.—The anti-knock characteristics of commercial *iso*pentane are related to the composition. Low concentrations of *n*-pentane and butane which reduce the octane number of the commercial product quantitatively may be determined accurately by the procedure outlined. The method employs a modification of the standard A.S.T.M. distillation apparatus and is based on a precise determination of the boiling temperature curve. The accuracy claimed is 0·5% for *n*- and *iso*pentane and 0·25% for *n*-butane. H. G.

1407. Determination of Total Water-Soluble Chlorides in Petroleum. J. W. Horne and L. F. Christianson. *U.S. Bur. Mines Report of Investigations*, No. 3517, June 1940.—In order quantitatively to determine the amount of salt in petroleum, it is necessary first to extract the salt from the oil, and secondly to measure the amount of extracted salt. To be effective the procedure adopted must be universally applicable to the various emulsions and salts which accompany petroleum; it must be accurate and precise; and finally it must be adaptable to either field or laboratory analysis. The technique used by the Bureau of Mines and described in this paper is claimed to fulfil all these conditions.

A representative sample of the oil is obtained and thoroughly mixed, after which a portion is measured for analysis. The measured oil is then diluted with xylene to dissolve wax, gum, and asphalt. To prevent any emulsion being formed, or to resolve any that has been formed, a stabilizer is added and the mixture heated and agitated violently to dissolve the salt. The oil is then separated from the water by centrifuging and the total quantity of water extract titrated for the dissolved chlorides. The quantity of water-soluble chlorides present in the oil is calculated as sodium chloride from the net millilitres of silver nitrate used in the titration. H. B. M.

1408.* Some Notes on Exhaust Gas Analysis. H. Fossett. *J. Instn aut. Engrs*, 1940, VIII (9), ix–xxiv.—The determination of exhaust-gas composition has a considerable field of usefulness in the testing and control of internal-combustion engines. The author first reviews published work on the composition of exhaust gases, and then outlines various methods of analysis.

Ballantyne's empirical rule for the relationship of H_2 and CH_4 to CO content has long been established, but was disproved in 1936 by D'Alleva and Lovell, who carried out very careful experiments on three engines. Data for the relationship of CO_2, CO, and O_2 to air/fuel ratio are shown graphically. It was found that the CH_4 produced was constant, being about 1·857% of the carbon in the fuel; this is equivalent to the formation of 0·15 mols. of CH_4 per molecule of C_8H_{17}, which was the composition of the fuel used.

Methods of exhaust gas analysis are : (*a*) Chemical analysis, (*b*) hot-wire catalysis, (*c*) relative density and (*d*) thermal conductivity. For chemical analysis the Orsatt apparatus is extremely useful. The thermal conductivity principle is most widely used for portable instruments recording air/fuel ratio. Differences exist in the calibration of different designs of these instruments; it would appear that a linear scale is incorrect. A characteristic of conductivity instruments is that, if the mixture strength is progressively weakened, beyond 14·7 : 1 the pointer will move back towards the rich end of the scale. Considerable caution must therefore be exercised when operating at the weak end of the scale. K. A.

Motor Fuels.

1409. Co-operative Fuel Research Motor-Gasoline Survey, Winter 1939–40. E. C. Lane. *U.S. Bur. Mines Report of Investigations*, No. 3524, June 1940.—The Co-operative Fuel Research Committee and the Bureau of Mines have already issued eight reports on properties of commercial motor fuels. This, the ninth, embodies data on 2033 samples, representing the products of eighty different companies. In addition, there are included data compiled by the Pacific Coast Technical Group for that region. For the purposes of this report, gasolines are again divided into regular-price, premium-price, and third-grade qualities. Table 1 gives data on gravity, sulphur content, vapour pressure, octane number, and distillation characteristics of commercial gasolines sold in twenty-one marketing areas in the U.S. during 1939–40. Averages for each of the grades are included in this table. These averages are assembled in Tables 2, 3 and 4. Table 5 records the minimum and maximum for each characteristic of the three grades of gasoline. Table 6 is for comparative purposes, and includes the same figures for the previous winter survey. H. B. M.

1410. Volatility and Anti-knock Properties of Hydrogenated Gasoline. A. V. Agafonov and C. K. Makarov. *Neft. Khoz.*, 1939, No. 8, 40.—Volatility characteristics and octane numbers have been determined for a number of Russian aviation gasolines, and various blends with *iso*-octane, light gasoline fractions, and alkylbenzene, with and without $PbEt_4$.

A method is given for the treatment of pressure distillate by means of which a high octane blending agent of high volatility is obtained and by reforming the residue of the pressure distillate a high-grade aviation petrol is produced. Blending hydrogenated light fractions of pressure distillate with i.b.p. of 60° C. for obtaining 100 octane fuel reduces the consumption of *iso*-octane 25–40%. The following composition is recommended: 15% light fractions + 30% *iso*-octane + 55% aviation gasoline. In this blend either straight-run gasoline may be used or hydrogenated gasoline obtained by reforming cracked ligroine. The distillation characteristics and the vapour pressure of this 100 octane fuel are within the specifications for aviation gasoline.

It is also possible to obtain 100 octane fuels if in the blend *iso*-octane is replaced by the fraction distilling between 120° and 165° C. of alkylbenzene, which is not obtained by blending alkylbenzene with gasoline alone. L. R.

1411. Patents on Motor Fuel. D. Lipkin. U.S.P. 2,210,942, 13.8.40. Appl. 20.10.36. Preparation of a fuel for internal-combustion engines by admixing a hydrocarbon of the motor fuel boiling range with a quantity of *iso*butyraldehyde to increase substantially the anti-knock value.

F. R. Bean. U.S.P. 2,211,313, 13.8.40. Appl. 1.7.38. Preparation of a motor fuel consisting of hydrocarbons which normally tend to deteriorate and a lower monoalkyl ester of *p*-hydroxyphenylamino acetic acid in an amount sufficient to inhibit said deterioration.

A. N. Sachanen and A. W. Francis. U.S.P. 2,211,732, 13.8.40. Appl. 10.2.39. Preparation of a motor fuel having the distillation characteristics of an aviation gasoline and a smooth boiling range. The fuel consists of a mixture of alkylbenzenes boiling above 220° F. and a gasoline fraction boiling below about 220° F.

Standard Oil Development Corp. E.P. 524,252, 1.8.40. Appl. 26.1.39. Preparation of hydrocarbons boiling mainly within the gasoline range by contacting with an alkylation catalyst a mixture of non-cyclic paraffin hydrocarbons containing a paraffin hydrocarbon having at least one tertiary carbon atom in the molecule and a further paraffinic hydrocarbon. H. B. M.

Lubricants and Lubrication.

1412. Theoretical and Experimental Researches on the Synthesis of Lubricants. M. G. Hugel. *Trans. Faraday Soc.*, 1939, **35**, 1054–1061.—The above aspects of the synthesis of lubricating oils from rubber are here discussed. The author applies Dunstan's and Thole's molecular weight/viscosity law to Andrade's viscosity/temperature equation

to discover what chemical constituents are responsible for varying viscosity effects. The differences between mineral and vegetable oils he considers due possibly to a dipole effect in the molecules of the latter.

In the synthesis of oils from rubber by hydrogenation under high pressure three reactions occur: cracking, cyclization, and hydrogenation. Catalysts can be chosen so as to determine which of these three effects is predominant. The author considers aliphatic oils best for lubrication below 300° C., mixed type for oils required to volatilize, and polycyclic aromatics for very high temperatures. M. McL.

1413. Regeneration of (Used) Oils. E. Schmitz. *Science et Ind.*, 1940, 290 bis. (Supplement to *Revue Mécanique*), 77–83.—The author puts the case for a national scheme for the recovery of used oils, particularly in war-time, pointing out that the practice is obligatory in Germany. The methods of regeneration are discussed together with the quality of oils so recovered. It is suggested that for efficiency and economy the oils be collected and regenerated in six different classes, viz.: (1) Light machinery, (2) Electrical and Turbine, (3) Automobile, (4) Aviation, (5) Marine diesel engine, (6) Rough industrial machinery oils, each group to be treated by the method appropriate to the quality required by the finished product. R. D. S.

1414. Use of Bleaching Earths in the Regeneration of Lubricating Oils. F. Bloemen. *Science et Ind.*, 1940, 290 bis. (Supplement to *Revue Mécanique*), 84–85.—The action of an earth may depend on absorption by the pores of the earth or adsorption by the activated surface, or in many cases chemical action by the particles. The latter appears to be due to the acid nature of the earth and to the tendency of the particles to behave as ions in consequence of the acceptance of an electric charge. Whether a particular earth is used or not depends on the oil to which it is to be applied, for the order of merit of a series of earths is not the same for different oils, since one of the above-mentioned mechanisms will be more effective on one oil than on another. Hence the choice of earth depends on the type of oil, and the type of refining to be employed. This is sometimes difficult, for often the oil to be treated is a mixture of, *e.g.*, diesel and aviation oil; especially is this so if one of the components is compounded. It is therefore suggested that there should be either a central laboratory for the analysis of used oils for recovery or, alternatively, each type of oil should be collected separately. R. D. S.

1415.* Deterioration Factors in Diesel Lubricants. C. G. A. Rosen. *Nat. Petrol. News*, 1.5.40, **32** (18), R.152.—The factors causing the deterioration of diesel lubricant include the time that the oil is in effective use and the frequency with which it is subject to heat, oxidation, or contaminating influences. Used oil, in some respects, is better than new oil. It has been found that used oil, particularly if compounded, has a higher film strength and often higher resistance to cylinder corrosion than new oil. On the other hand, new oil is less likely to cause bearing corrosion. The most important factor governing oil life is temperature, and all efforts should be made to reduce crankcase temperature. Flame impingement on cylinder walls causes local hot spots and aggravates cylinder wall deposits. Bearings should be designed with rapid heat dissipation in view. A thermal sponge behind a thin layer of babbitt has been found satisfactory. Since the diesel engine is an oxidizing apparatus, lubricants should show a maximum resistance to change due to oxidizing influences. H. G.

1416.* Synthetic Fats in Grease-making. A. W. Burwell and J. A. Camelford. *Petroleum*, 1940, **2** (3), 75–78.—One of the most ready sources of supply of saponifiable materials which can be used for grease manufacture is the oxidation under controlled conditions of petroleum hydrocarbons. Among the products formed in this process quantitative yields are obtained of acids, primary and secondary alcohols, esters, keto-alcohols, lactones, and ketones. Many of these oxidation products are readily saponifiable with bases ordinarily used in grease manufacture, and soaps of Na, Ca, Al, Pb, K, Mg, and Ba have been prepared by direct saponification and used in lubricating greases.

It is claimed that the greases so obtained are free from bleeding in storage, from separation after working, and that most of them after heating above their melting point return to their original consistency without separation.

The method of manufacturing the greases is outlined. It is essential that these products be finished exactly neutral or slightly acidic, never alkaline. Barium greases have been made very satisfactorily by direct saponification with $Ba(OH)_2$ and showed worked penetrations of 230–280 at 77° F. and melting points above 350° F. In addition, such products could be heated to 420° F., and on cooling were identical with the original grease.

The soaps can also be made by double decomposition and then dissolved in the appropriate mineral oil base.

Experiments were carried out in the manufacture of aluminium stearate greases. It was found that if this soap were blended with mineral oil containing a small amount of some of the esters, or mixtures of esters with high-molecular-weight ketones and alcohols prepared from petroleum hydrocarbons, a greatly improved grease resulted.

D. L. S.

1417. Patents on Lubricants and Lubrication. W. H. James. U.S.P. 2,209,976, 6.8.40. Appl. 20.1.38. Preparation of a mineral-oil composition consisting of a refined viscous mineral oil and a small amount of an *N*, N^1-dithiobisalkylamine.

I. M. Colbeth. U.S.P. 2,210,140, 6.8.40. Appl. 6.11.31. Lubricant consisting of a major proportion of mineral oil and a minor proportion of an ester derived from a long-chain aliphatic acid and a short-chain aliphatic alcohol having not more than two hydroxyl groups. The amount of the ester is at least 0·5% of the lubricant.

W. A. Whittier, N. D. Williams, and H. L. Moir. U.S.P. 2,211,306, 13.8.40. Appl. 19.12.35. Preparation of a lubricant by chemically combining a small amount of sulphur with a fatty body, adding phosphorus to the sulphurized body, and heating to a temperature not much in excess of 230° F. until the reagents have prevented substantial fuming of phosphorus.

B. Folda. U.S.P. 2,211,373, 13.8.40. Appl. 8.8.39. Preparation of a thread lubricant consisting of a cup grease and zinc dust rendered chemically stable by the addition of a free fatty substance in amount sufficient to neutralize the free alkaline ingredients of the cup grease and to leave an excess of at least 1/10 of 1% by weight of the finished compound.

E. M. Steffen. U.S.P. 2,211,442, 13.8.40. Appl. 15.9.36. Preparation of synthetic compositions useful for blending with lubricating oils. Rubber material is subjected to the action of anhydrous aluminium chloride in the presence of metallic iron under conditions effective to produce conversion products.

B. T. Brooks. U.S.P. 2,211,687, 13.8.40. Appl. 18.3.37. Preparation of a lubricant consisting of a mineral lubricant and a small amount of stearone.

Carbide and Carbon Chemicals Corp. E.P. 524,847, 15.8.40. Appl. 18.2.38. Production of a water-dispersible composition for use in textile lubricants comprising a major proportion of an oil, and a lesser quantity of a surface active agent consisting either of a 1, 2 di-substituted glyoxalidine or of a carboxylic acid addition product of these compounds.

H. B. M.

See also Abstract No. 1419.

Gas, Diesel and Fuel Oils.

1418.* Diesel Fuel in Houdry Distillate Close to Straight-run Quality. W. S. Mount and E. T. Scafe. *Nat. Petrol. News*, 10.7.40, **32** (28), R. 246.—When the limit of the availability of straight-run diesel fuel of suitable quality is reached, the adaptability of the Houdry catalytic cracking process is important. A typical cetane number of fuel so produced is 46, as compared with 35 for thermal cracked fuel. Catalytically cracked fuels from Pennsylvania and Oklahoma crudes have only slightly lower cetane numbers than straight-run products of similar characteristics, and they yield equally well to ignition accelerators. In other respects they resemble the straight-run distillates.

H. G.

1419.* Diesel Fuel and Lubricants. L. C. Welch. *Nat. Petrol. News*, 15.5.40, **32** (18), 38.—There is a growing tendency to use the light grades of domestic heating oils for diesel fuel, and also to model specifications on that of light fuel oil. Significant factors in present-day specifications are: Ignition quality (cetane number), cleanliness, viscosity (to minimize pump wear), pour point, distillation range (to provide clean combustion), sulphur, alkali and acid contents (to minimize corrosion). Opinions relative to the type of lubricant best suited to the diesel engine differ. The present tendency is to emphasize the need for low carbon forming and oxidation tendencies. The use of inhibitors is growing, and in some cases detergents are added in order to increase the scavenging of deposits. H. G.

Asphalt, Bitumen and Road Construction.

1420. Subgrade Pressures under Flexible Road Surfaces. A. T. Goldbeck. *Highway Research Board Proc. Nineteenth Annual Meeting*, 1939, 164–174.—The author presents results of preliminary tests made to determine the subgrade pressures under flexible road surfaces of varying thickness. The tests were made on soil–clay mixtures, containing sufficient water to give the requisite stability, contained in a wooden bin.

The mixture was rolled in 3-in. layers with a sheep's foot roller, followed by a heavy hand concrete roller.

The surfacing layer was composed of stone screenings of different thickness.

Loads were applied through elliptical bearing blocks having areas equal to the area of contact of tyres suitable for loads of 4000, 8000, and 12,000 lb., and soil pressure measurements were made by means of the soil pressure cell described in a previous paper.

Load-indentation tests were also made in order to determine whether the maximum subgrade pressures were greater or less than the subgrade supporting value.

The apparatus consisted of steel bearing blocks through which the load was applied in increments by means of a hydraulic jack, the indentation being measured by means of two Ames dials reading to 0·001 in. In making a test a hole was formed in the surfacing material and a flat level surface then made in the subgrade material to support the bearing block. Tests on the surfacing material were also made in a similar manner. A. O.

1421. Present Design Practice and Construction Developments in Flexible Pavements. B. E. Gray. *Highway Research Board Proc. Nineteenth Annual Meeting*, 1939, 175–192.—The author summarizes the replies to a questionnaire concerning the practice of various State highway departments in design and construction of bituminous surfacing. A. O.

1422. Report of Committee on Fillers and Cushion Courses for Brick and Block Pavements. J. S. Crandell. *Highway Research Board Proc. Nineteenth Annual Meeting*, 1939, 275–278.—Details of construction and results of tests on the Brick Filler Test Road in Ohio were given in previous reports, and the present report summarizes results of investigation of the changes in physical characteristics and conditions of five asphaltic bitumen fillers during four years' service.

Observations were made on the pavement surface condition; small areas of the bricks were removed, the adhesion of filler to brick was noted, and samples of filler prepared for testing by cleaning and melting. Results of tests on the recovered filler are compared with tests on the original fillers. All fillers showed an appreciable increase in softening point, decrease in ductility and penetration, and increase in asphaltene content. No consistent relationship was observed between the change in properties and type of petroleum base. Exudation of the filler appears to be greater with fillers of lower softening point and higher penetration at 46° C. With the fillers employed, bonding of filler to brick and low exuding properties appeared to be incompatible, but no loose bricks were observed in any section, thus indicating that the fillers behave satisfactorily without bonding to the brick. A. O.

1423. Status of Soil Stabilization in United States, December 1939. W. H. Mills. *Highway Research Board Proc. Nineteenth Annual Meeting*, 1939, 491–497.—The author summarizes the replies to a questionnaire sent to State highway departments requesting a report of the mileage of all types of stabilized road constructed since 1924. A. O.

1424. Soil Stabilization with Emulsified Asphalt in the Mid-Continent Area. B. S. Scoggin. *Highway Research Board Proc. Nineteenth Annual Meeting*, 1939, 498–503.—Details are given of emulsified asphalt soil stabilization projects covering an area equal to 225–250 miles of 18-ft. roadway. Cost of the work ranged from 22 to 28 cents per yard of 4 in. compacted thickness, and the following conclusions were reached from the work: maximum dehydration is a more important factor affecting durability than maximum density at time of compaction. The quantity of emulsion should be determined by test mixtures of the emulsion and representative samples of the soil using some known efficiency test such as the McKesson. Four-inch compacted depth should be the minimum thickness, while if the base is a subsoil of high plastic index, the minimum should be 6 in. Control tests should be made on the finished work to ensure that the material laid meets the minimum requirements of the efficiency test. A. O.

Special Products.

1425. Fatty Acids from Paraffin Wax—Purification for Soap Making Purposes. Anon. *Chem. Tr. J.*, 19.7.40, **107**, 38.—Fatty acids obtained by the catalytic oxidation of paraffin waxes (*e.g.*, those from Fischer–Tropsch plants) contain, in addition to the straight acids, oxy-acids and internal lactones which cannot be completely removed by saponification, followed by extraction or distillation, and recovering the fatty acids by acidification. The resulting acids are liable to discolour and have an unpleasant odour. A process has now been worked out by the I.G. Farbenind. A.-G. (E.P. 518,963 of 13th March, 1940) for the purification of the crude fatty acids by fractional distillation below 10 mm. pressure of mercury (preferably at 2 mm.), removing the fatty acids with acid value >330 at a temperature up to about 130° C., and then recovering with the application of steam under 2 mm. mercury, the soap forming fatty acids, boiling up to 260° C. with acid value 200–330. Complete separation of the fatty acids consists of saponification of the oxidation products, removal of unsaponifiable components by extraction with aqueous ethyl alcohol, followed by benzine and decomposition of the soaps with 50% of H_2SO_4. The crude fatty acids are finally purified by vacuum fractional distillation as described in the patent. C. L. G.

1426. Patents on Special Products. G. W. Johnson. E.P. 523,892, 25.7.40. Appl. 9.9.38. Manufacture of meta-diaza-compounds by heating cyclic compounds with ammonia and aldehydes or compounds splitting off aldehydes.

A. G. Green. E.P. 524,011, 29.7.40. Appl. 25.10.38. Manufacture of a product having valuable therapeutic properties by the reaction of an acetic aldehyde bisulphite on para-aminobenzene-sulphonamide.

Consortium für Elektrochemische Industrie, G.m.b.H. E.P. 524,086, 30.7.40. Appl. 21.1.39. Manufacture of hydroxycarboxylic acid esters by the catalytic reduction of formic ester condensation products with carboxylic esters.

Röhm and Haas Company. E.P. 524,151, 31.7.40. Appl. 23.1.39. Preparation of *iso*phorones containing at least 15 carbon atoms by heating a saturated alkyl monoketone with a member of the group consisting of an oxide, hydroxide, amide, and alkoxide of an alkali metal at a temperature above 100° C., so as to split out water.

The Distillers Company, Ltd. E.P. 524,156, 31.7.40. Appl. 23.1.38. Production of polymers of styrene by subjecting a solution thereof to the action of an activating bleach earth, an activated clay and/or silica gel at a temperature of 20–90° C.

E.I. Du Pont de Nemours. E.P. 544,163, 31.7.40. Appl. 23.1.39. Manufacture of saturated aliphatic carboxylic acids by oxidizing long-chain unsaturated fatty acids with highly concentrated nitric acid at ordinary or slightly elevated temperature in the presence of a vanadium catalyst.

N.V. Orgachemie. E.P. 524,319, 2.8.40. Appl. 27.1.39. Preparation of stable concentrated quinine solutions by dissolving a mono-salt of quinine with the aid of ascorbic acid.

I.G. Farbenindustrie A.-G. E.P. 524,349, 5.8.40. Appl. 27.1.39. Production of melamine by acting with gaseous anhydrous ammonia at elevated pressure on dicyandiamide at a temperature above 100° C.

E.I. Du Pont de Nemours. E.P. 524,470, 7.8.40. Appl. 30.1.39. Manufacture of alkoxy-*cyclo*hexanols by reacting *cyclo*hexene oxide with a monohydric aliphatic alcohol of at least 6 carbon atoms.

J. W. C. Crawford. E.P. 524,521, 8.8.40. Appl. 31.1.39. Manufacture of organic condensation products by condensing an olefinic compound derived from a chlorinated paraffin hydrocarbon with acids or acid anhydrides of specific formula.

I.G. Farbenindustrie A.-G. E.P. 524,696, 13.8.40. Appl. 3.2.38. Manufacture of *para*-aminobenzaldehydes by reacting a secondary N-alkylaniline with a phosphorus oxychloride and formyl-N-methylaniline.

H. E. Potts. E.P. 524,715, 13.8.40. Appl. 4.2.39. Improvement in a process for the treatment of liquid distillable carbonaceous materials containing solid matter in dispersion with hydrogen or gases containing free hydrogen. A tube preheater provided with return bends is employed, and interchangeable tube-like pieces constructed of brittle ceramic materials or the like are inserted in the return bends.

Carbide and Carbon Chemical Corp. E.P. 524,759, 14.8.40. Appl. 15.3.38. Manufacture of olefine oxides by the direct chemical combination of molecular oxygen with olefins. A gaseous mixture containing oxygen and olefine is passed through a confined space containing a catalyst at a temperature between 150° and 400° C. The amount of olefine oxide produced per unit volume of catalyst present is controlled by maintaining a mass velocity of the gaseous mixture of not less than 0·2 lb. per sq. ft. per second.

H. E. Potts. E.P. 524,760, 14.8.40. Appl. 7.2.39. Use of mixtures of metal sulphides as catalysts in the production of hydrocarbons from carbonaceous materials. The catalysts are obtained by mixing in a dry state ammonium thio salts of metals of the sixth group of the periodic system with carbonates or salts of organic acids of metals of the iron group and heating the mixture at temperatures between 300° and 500° C. at least until the formation of ammonia ceases.

Consortium für Elektrochemische Industrie, G.m.b.H. E.P. 524,849, 15.8.40. Appl. 9.2.39. Manufacture of butadiene from 1 : 3-butylene glycol by splitting off water in the presence of an amount by volume of water many times as great as the amount of butylene glycol present.

G. W. Johnson. E.P. 524,918, 19.8.40. Appl. 13.6.38. Production of butadiene by dehydrogenation of butylene. A gaseous mixture of normal butylene is led with steam at a temperature between 500° and 700° C. over a catalyst consisting of more than 50% zinc oxide, together with one or more oxides or salts of the oxy-acids of chromium, vanadium, molybdenum, uranium, or tungsten.

I.G. Farbenindustrie A.-G. E.P. 525,136, 22.8.40. Appl. 14.2.39. Manufacture of mustard oils by heating chlor-olefines in which a chlorine atom is situated in α-position to an olefinic double bond with an aqueous solution of thiocyanic acid salt.

Carbide and Chemicals Corp. E.P. 525,142, 22.8.40. Appl. 15.2.39. Preparation of *iso*phorone by contacting acetone vapours with a condensation catalyst at a temperature between 200° and 700° C.

Vereinigte Glanzstoff-Fabriken A.-G. E.P. 525,147, 22.8.40. Appl. 15.2.39. Preparation of amines of petroleum hydrocarbons. Raw or purified mineral oil is treated with chlorine whilst cooling, and ammonia is caused to act on the chlorinated product in the presence of indifferent solvents such as methyl alcohol, ethyl alcohol, which are capable of dissolving simultaneously ammonia and chlorinated petroleum to a considerable extent.

Wingfoot Corp. E.P. 525,172, 22.8.40. Appl. 16.2.39. Preservation of rubber or oils by treating them with the reaction product of diethylene glycol or monoalkyl ether thereof with an amine in which each amino-group present has at least two aromatic substituents on the nitrogen.

A. L. Stillman. E.P. 524,991, 20.8.40. Appl. 12.1.39. Manufacture of a stable liquid fuel having coal particles equally distributed throughout and consisting of a mixture of 40–70% by weight of fuel oil and from 60–30% of coal of the bituminous type which has been subjected to a grinding action in the presence of oil so that it passes a 325-mesh sieve. H. B. M.

Detonation and Engines.

1427. Diesel Engines Underground. I. Composition of Exhaust Gas from Engines in Proper Mechanical Condition. *Report of U.S. Dept. of the Interior*, May 1940. J. C. Holtz, L. B. Berger, M. A. Elliott, and H. H. Schrenk.—An investigation of the suitability of diesel engines for underground use in mines has been initiated by the U.S. Bureau of Mines. This report—the first of a series—deals with the composition of exhaust gases over the rated operating ranges of two commercial four-stroke diesel engines, excluding the effect of such factors as excessive wear, maladjustment, etc. The effect of exceeding the maximum fuel quantity allowed by the maker's adjustment was also studied.

The engines were four-cylinder units, rated at 44 and 70 max. b.h.p., respectively. A fuel of 78 cetane number was used. Exhaust gas samples were collected for determination of CO_2, O_2, CO, CH_4, H_2, and N_2. The exhaust pipe was extended about 9 ft. beyond the sampling points; this proved necessary to avoid contamination with air drawn back into the pipe by pulsations. The methods of sampling and analysis are described in detail, together with the calculations and a discussion of probable accuracy.

Graphs are presented correlating exhaust-gas composition with fuel–air ratio as well as air–fuel ratio. It is pointed out that the former has advantages when dealing with the wide range of ratios occurring in diesel operation. The relation between composition and fuel–air ratio was the same for both engines. As long as the rated maximum load was not exceeded the CO content was sufficiently low to permit adequate dilution and safe removal from underground workings. If this load was exceeded, the CO hazard was equal to that of the gasoline engine. The CO concentration was a minimum at 0·03 : 1 fuel–air ratio; at still leaner ratios it increased somewhat.

The concentration of oxides of nitrogen was also a maximum at about 0·03 : 1 fuel–air ratio, when values of 440 and 676 parts per million by volume were observed. This is dangerous for even short exposures; thus, oxides of nitrogen constitute a hazard to be considered.

Aldehyde concentration reached 5 p.p.m. in one engine and 31 p.p.m. in the other, the maximum occurring at low fuel–air ratios. It is suggested that exhaust odour and irritating effect may be related to aldehyde concentration, but the data are not complete. The concentration of CO_2 was between 2% and 13%; this gas must also be considered when estimating ventilation requirements. Soot appeared to be present in the exhaust even when excess air was available.

The chemical aspects of the diesel combustion process are discussed in relation to the published work of Boerlage and Broeze. These investigators postulated that combustion is characterized by two simultaneous processes: direct oxidation and thermal decomposition. It is concluded that the above results confirm this idea.

K. A.

1428.* Octane Number Problem from the Automotive Viewpoint. J. B. Macauley. *Nat. Petrol. News*, 1.5.40, **32** (18), 30.—An examination of figures relating to average compression ratios and average octane numbers over the past 10 years shows that each function has increased in a similar manner. It is reasonable to suppose, therefore, that if octane numbers continue to increase, engine design will progress in order to profit by the increase in potential power. The use of superchargers is suggested as a feasible means of attaining greater power outputs. Engine factors militating against extra power production are: Variations in spark setting, combustion-chamber deposits, variations due to manufacturing tolerances, variations in fuel type and type of operation. The quantitative effect of these factors is discussed. The author suggests the routine application of solvent processes to minimize combustion-chamber deposits. H. G.

1429.* New Fuel Data from Tests Show How Maintenance Improves Mileage. Anon. *Nat. Petrol. News*, 22.5.40, **32** (21), 36.—In a series of road tests a representative number of 1940 passenger cars were driven for 100,000 miles at an average speed of 50 m.p.h. Full details are not yet available, but the results so far indicate that the average top speed after 100,000 miles was only 2 m.p.h. lower than that of a second group of cars driven only 1700 miles. The average time taken to accelerate from 10 to 50 m.p.h. showed practically no change, and gasoline mileage per gallon showed a slight rise at the end of the tests. H. G.

Economics and Statistics.

1430. Natural-Gasoline Plants in the United States, 1st January, 1940. G. R. Hopkins and E. M. Seeley. *U.S. Bur. Mines Information Circular*, No. 7126, July 1940.—Figures included in the Bureau of Mines' latest biennial survey of natural-gasoline plants in the U.S. reveal that the tendency noted during the past 10 years for manufacture to be concentrated in fewer establishments has now been checked. On 1st January, 1940, there were 729 plants in existence, or only twelve fewer than on 1st January, 1938; 671 of these were in operation and the remainder shut down. The total daily capacity of these plants was the highest ever recorded, and showed an increase over the January 1938 figure of 5%. Owing to a hold-over of capacity built before proration, and equally to the continued practice of building up to peak gas production, a large percentage of this capacity was idle. In 1938 and 1939 it is estimated that idle capacity was in the region of 47% and in 1937, 40%.

Texas, California, and Oklahoma together accounted for 84% of total operating capacity on both 1st January, 1938, and 1st January, 1940. The appearance of recycling plants designed to process the gas for condensate and return the residue gas to producing formations was reflected in this survey. The returns included ten such plants, each with a capacity of 246,000 gal. H. B. M.

1431.* World Production of Petroleum—Venezuela. J. Bermejo. *Bol. Inform. Petroleras*, April 1940, XVII (188), 82–92.—Venezuela commenced production in 1917 with some 18,000 tons, rising to the important figure of 30½ million tons in 1939. The article quoted gives interesting particulars, both historical and statistical, of the remarkable growth of the oil industry. A full bibliography is added. H. I. L.

BOOK REVIEW.

Hydrocarbon Chemistry—A General Discussion reprinted from the Transactions of the Faraday Society. Pp. 287. Gurney and Jackson, 98 Gt. Russell Street, London. Price 12*s*. 6*d*.

This publication covers the papers presented at a three-day Discussion on Hydrocarbon Chemistry held by the Faraday Society.

The volume commences with an introductory paper contributed by the President, Professor E. K. Rideal. The subject-matter is then considered under the following heads :—

Part I.—Homogeneous Thermal Reactions of Hydrocarbons.
Part II.—Catalytic Reactions of Hydrocarbons.
Part III.—The Mechanism of the Technical Synthesis and Transformation of Hydrocarbons.
Part IV.—Olefine Polymerization.

Professor Rideal explains in his introductory paper that while the technical development of certain phases of hydrocarbon chemistry has attained a high standard, the theoretical aspect is confused in its general outlook. The main official purpose of the Discussion, therefore, has been to direct the attention of those academically inclined to the wide variety of such problems which await solution and elucidation, and in consequence the book is academic rather than technical in character.

The first three papers in Part I deal mainly with structure and activation energies of hydrocarbon molecules, the remaining nine papers in this part giving an account of certain of the views held on homogeneous thermal reactions of hydrocarbons. This section is of particular importance to the petroleum technologist, for it deals with many matters which are the basis of the thermal cracking process, covering a wide field from chain reactions to the pyrolysis of hydrocarbon groups and individual hydrocarbons.

Part II is devoted to catalytic reactions of hydrocarbons. A comprehensive paper on catalytic ring closure of open-chain hydrocarbons, by Professor Taylor and Dr. Turkevitch, and two papers by Dr. Farkas on isomerization occupy most of this interesting section.

In Part III the technical synthesis and transformation of hydrocarbons is considered. In the first two papers the mechanism by which long-chain hydrocarbons are built up from water-gas in the Fischer–Tropsch process is discussed. The third paper, contributed by Dr. Pier of the I.G. Farbenindustrie, deals with the coal-hydrogenation process. The important subject of cyclization of saturated straight-chain to aromatic hydrocarbons has attracted three papers. Divergent views as to the mechanism of the reaction are put forward by Mr. Pitkethly and Dr. Steiner of the Sunbury Research Station, and by Dr. Hoog and his collaborators of the Bataafshe Petroleum Maatschappij. The recently discovered and most interesting reaction in hydrocarbon chemistry—namely, the catalytic condensation of an olefine to an *iso*-paraffin—is excellently dealt with by Drs. Dunstan and Birch. These authors are to be congratulated on their sound and careful work on this important and elegant method, which is destined to have profound and far-reaching effects on hydrocarbon technology.

The last part, Part IV, is devoted to olefine polymerization, in which papers embracing the formation of dimeric molecules, of medium-length molecules for use as lubricants, and of high-molecular-weight plastics are presented.

This book is undoubtedly one of the best publications on hydrocarbon chemistry and comprehensive surveys from a research standpoint which has appeared in

English. At the published price of 12*s.* 6*d.* it is a noteworthy bargain. Many of the views put forward are controversial, and divergent opinions are the rule rather than the exception. This is one of the most important functions of the work, in so far as it has collected and recorded a consensus of opinion of admitted authorities on hydrocarbon chemistry. The volume is so definitely academic that it will make little appeal to the technologist, but will be extremely valuable to the chemist and research worker.

T. G. HUNTER.

BOOKS RECEIVED.

Petroleum Development and Technology, 1940. Trans. of the American Institute of Mining and Metallurgical Engineers, Vol. 136. Pp. 608. Published by the Institute, 29 West 39th Street, New York, U.S.A. Price $5.

This volume is the fifteenth of the Petroleum Development and Technology Series of the Petroleum Division A.I.M.E., and contains papers presented before the Division during the year under review. Abstracts of the most important papers have already appeared in the abstracts section of the *Journal of the Institute of Petroleum*.

There are five chapters, devoted respectively to (1) Production Engineering, (2) Engineering Research ,(3) Petroleum Economics, (4) Production, Domestic (U.S.A.) and Foreign, and (5) Refining.

British Standard Methods for the Sampling and Examination of Bituminous Road Mixtures. (Revised August, 1940.) No. 598—1940. Pp. 41. British Standards Institution, 28, Victoria Street, London, S.W. 1. Price 3*s.* 6*d.*

Experience gained in the adoption of the first issue of this British Standard (published in February 1936) showed that a number of modifications were desirable. The following are some of the more important modifications which have been incorporated in this present revision :—

(*a*) The size of the samples required for testing has in nearly all cases been increased.

(*b*) The test for the determination of bitumen content has been revised.

(*c*) A modified test for the rapid determination of bitumen content which gives a good approximation is outlined in an appendix as being useful in those laboratories where routine testing is carried out.

(*d*) The two alternative methods for the recovery of bitumen which have been included give similar results.

(*e*) The tests on mineral aggregate have not been included, as they are provided for in B.S.S. 812.

(*f*) The section dealing with the identification of mineral aggregate has been completely revised.

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Geology and Development.

1432.* Recent Developments in South Mid-Continent. L. W. MacNaughton. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1025–1032.—The South Mid-Continent occupies more than 250,000 sq. miles, and includes Arkansas, south-eastern New Mexico, and all of Mississippi, Louisiana, and Texas, except the Gulf Coast.

The more important developments were in Mississippi, New Mexico, and particularly in West Texas. By major extensions to old fields, presence of the deeper Permian "pay" in the North Cowden field, and the discovery of more production from the Ordovician, West Texas was much the most important district in the South Mid-Continent area.

A period of decreasing reserves, however, ensued in 1939, since production exceeded additions to reserves represented by new discoveries. More than 500 million brl. of crude oil came from the South Mid-Continent area in 1939; new fields replaced less than one-third of this production. G. S. S.

1433.* Developments in West Texas and South-Eastern New Mexico during 1939. D. M. Secor, W. C. Fritz, and W. W. West. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1033–1043.—The results of drilling in 1939 led to important extensions to, and linking of, productive fields. Nine new pools were discovered in West Texas; two of these produced from the Ordovician, two from the Pennsylvanian, and five from the Permian. In south-eastern New Mexico, of 648 wells drilled, 551 were completed as oil wells and twelve as gas wells. Five new pools were discovered, all producing from Permian rocks.

More than 100 million brl. were obtained from the two districts in 1939, and there are indications that reserves may be expected to be materially greater than hitherto expected. G. S. S.

1434.* Developments in North and West-Central Texas, 1939. K. A. Mygdal. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1044–1061.—At least 90% of the total production of this area to date has come from the major positive structural features, the Electra, Muenster, and Bend arches.

It is likely that important oilfields will continue to be discovered along the crests of these features, but increased attention is being given to the bordering basins, especially the Fort Worth syncline. From this huge depression, five new fields were found in 1939, representing as a group the most important of the new discoveries for the year.

New discoveries, important extensions, and new pay zones are listed in tabular form. Discussion is limited to the significant geological and economic deductions which can be drawn from these discoveries and from the important dry holes.

Drilling was active through 1939, and was increasing at its close. The total number of wells drilled in the North Texas district declined, though there was a moderate increase in the west-central district. No important change occurred in the total production figures for either district; drilling and production figures are furnished. G. S. S.

1435.* Developments in East Texas during 1939. H. J. McLellan and E. A. Wendlandt. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1062–1068.—During 1939 less drilling was carried out in East Texas than at any time since the discovery of the East Texas field; one small oilfield and one small oil- and gas-field were discovered during the year. From new depths in three old gas-fields, gas and distillate production was obtained.

Few important exploratory tests were drilled, and in most fields only routine development occurred. On 1st January, 1940, there were forty-five active operations, thirty-six of which were in proved areas and nine were exploratory tests.

Brief reference is made to the new fields and producing areas, and to the field developments and more important exploratory tests. G. S. S.

1436.* Developments and Status of Oil Reserves in South Texas, 1939. L. B. Herring. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1069–1078.—The South Texas area is divided into three districts, San Antonio, Laredo, and Corpus Christi. The former includes

all pre-Eocene production, the Laredo all Eocene production, and the Corpus Christi district all post-Eocene production. They also have distinct types of crudes and in most instances distinct types of accumulation.

Thirty new pools were added during 1939, but no major discovery is known to have resulted; fifteen were gas wells and fifteen were oil wells. Data on these pools are supplied in tabular form.

It is estimated that 79 million brl. of crude oil and condensate were discovered in 1939. Oil reserves total 1260 million brl., which, based on the previous year's production, are equivalent of 15·5 years' supply. Present reserves are 300% more than on 1st January, 1934. G. S. S.

1437.* Review of Developments in 1939, Gulf Coast of Upper Texas and Louisiana. O. L. Brace. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1079–1091.—Developments in this area during 1939 have shown little important change from those of previous years. Discoveries have slightly decreased in number, a total of thirteen for Louisiana and ten for Texas being recorded; the quality of discovery has, moreover, greatly depreciated. It is probable that no more than three or four of these fields will ultimately reach major importance.

In detailed descriptions of the discoveries, it is pointed out that a large number of the new fields are of the low relief, faulted type; these have subsequently become an increasingly important source of new reserves.

A notable feature of the year has been the development of important oil-bearing horizons on the flanks of old producing fields. G. S. S.

1438.* Developments in Southern Arkansas and Northern Louisiana during 1939. W. B. Weeks and J. Purzer. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1092–1099.—Production for Southern Arkansas and Northern Louisiana during 1939 was only slightly less than that for the previous year, viz.: *1938*, 46,900,165 brl., *1939*, 46,608,465 brl.

In Southern Arkansas the main object of prospecting centred on the Smackover limestone. In Northern Louisiana the lower Glen Rose and Cotton Valley formations gave rise to increased activity. An analysis of wild-cat wells showing the deepest formations tested is given in tabular form.

Other tabular matter furnished indicates dry holes drilled during 1939 which are considered important in having assisted in establishing the limits of the Smackover limestone producing trend, the limits of possible producing area within the Cotton Valley section; or have provided tectonic or stratigraphic data not previously available. G. S. S.

1439.* Developments in Rocky Mountain Region in 1939. C. E. Dobbin. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1100–1111.—This region in 1939 had no relatively important discoveries in unproved areas. In certain old fields, however, several discoveries were made, including: (1) a widespread and rather prolific oil zone in the Minnelusa sandstone (Pennsylvanian) in the Lance Creek field, Wyoming; (2) the development of deeper oil zones in the Tensleep sandstone (Pennsylvanian) in the Wertz field, Wyoming; and (3) the finding of oil in the second sand of the Dakota group (Up. Cretaceous) in the Fort Collins field, Colorado.

Important extensions were made to the Cut Bank and North Cut Bank fields, Montana, the Lance Creek field, Wyoming, and the Wilson Creek field, Colorado. At the north end of the main oil-producing part of the Cut Bank field and down dip slightly from three neighbouring oil wells, the Sunburst Sand yielded the largest gas well yet found in Montana. This had an estimated initial production of 80 million cu. ft. per day. G. S. S.

1440.* Significant Developments in California, 1939. E. R. Atwill. *Bull. Amer. Assoc. Petrol. Geol.*, 1940, **24**, 1112–1125.—Four new oilfields were discovered in California during 1939. They are all situated in the central part of the San Joaquin Valley: North-East Coalinga, Paloma, Strand, and South-East Mt. View. To date, one only, North-East Coalinga, has been definitely established as a major field.

The North-East Coalinga field produces from 200 ft. of continuous Gatchell oil sand

(Middle Eocene) at a total depth of 8237 ft. The initial production rate was 4225 brl. per day. Structurally, the field is a long south-east plunging fold (Coalinga anticline), having a definite bow on its east flank. The field will probably include 1200 acres and have an ultimate production of 100 million brl. of oil.

Paloma ranks as second in importance of the new fields, and appears likely to become one of major proportions. Structurally, the field is probably related to Coles Levee (Stevens zone, Upper Miocene). Initial production was 2280 brl. per day.

The Strand also produces from the upper part of the Stevens zone, and gave an initial production of 1306 brl. per day. The structure is a small flat anticline, approximately 300 acres in extent. Production may ultimately total 10 million brl. from the sands known at present.

South-East Mt. View gets its production from a non-marine series of sand in the Middle Pliocene. The initial yield was 3800 brl. per day. Probably less than 200 acres, however, will be included in the field, and its ultimate production may not exceed 2 million brl. of oil.

Extensions of known fields include Coles Levee, Greeley, Montebello, Dominguez, and Rosecrans.

Wild-cat drilling declined. Moreover, many of the wells drilled were located on doubtful geological prospects, indicating that the possibilities of new discoveries are remote. G. S. S.

1441. Gulf Coast Looms Larger in National Oil Picture. Anon. *Oil Wkly*, 23.9.40, **99** (3), 39.—The Gulf Coast area holds one-fifth of the present known producible crude oil reserves of the U.S.A. At present it is giving 11% of the country's crude. The rate of discovery of new fields shows no signs of the area being exhausted, and the reserves were estimated to be 3,873,085,099 brl. on 1st July, 1940.

Tables show the reserves for this area as compared with those of other States, and the reserves, annual production, wells drilled, and new fields found yearly since 1935. The number of new fields and new sands below 10,000 ft. are listed since 1936. Certain fields and counties are shown to be outstanding in reserves. Deep drilling and geophysical activity are discussed.

Drilling, production, and reserve data are given by fields and counties, and the production is given by fields by years. G. D. H.

1442. Gulf Coast Development Trend is Away from Salt Domes. J. M. Vetter, *Oil Wkly*, 23.9.40, **99** (3), 39, 47.—Within the past few years the search for accumulation on partly explored salt domes has continued, but this phase of exploration has been secondary to the development of a new type of structure which has no apparent relation to salt domes. Chronologically Gulf Coast prospecting falls into three stages: during the first the piercement type of salt dome was discovered; in the second there was the deep-seated or non-piercement type; and in the third the non-salt dome structures with closure of the downthrown side of faults. There are, however, fields which do not conform strictly to any of these types, or are hybrids.

Before the application of geophysics in 1924, location of piercement type of domes was difficult, but geophysics soon added thirty discoveries to the thirty odd previously discovered. Since 1928 attention has been paid to the non-piercement type, and these fields have generally proved more prolific and larger in areal extent than the piercement type of domes. There are over a hundred of this type. In 1933 the third phase opened, although the structural significance was not at first appreciated fully. These structures have relatively little structural relief and are closed against faults, as at Amelia, Tepetate, and Joe's Lake. Structurally they are far less complicated than those caused directly by salt intrusion, but the lack of pronounced uplift increases the difficulty of discovery. G. D. H.

1443. Gulf Coast Oilfields, Salt Domes, and Prospects. Anon. *Oil Wkly*, 23.9.40, **99** (3), 83–179.—Brief notes are given for the fields, which are arranged alphabetically for each county, the latter being themselves in alphabetical order for each State. These notes deal with the means of discovery, structure, producing formations, sand thickness, extent of development, daily production, estimated ultimate recovery, estimated remaining reserve, oil gravity and outlet, the deepest well, number of wells running on 1st September, 1940, and the principal leaseholders. G. D. H.

1444. Mississippi Entering Settled Exploration Stage. G. Weber. *Oil Gas J.*, 8.8.40, **39** (13), 22.—The Upper Cretaceous play extending through Central Mississippi has revealed the existence of blanket sand bodies over a wide area in the Selma Chalk, Eutaw, and Tuscaloosa. Few outstanding structures like Tinsley or Jackson have been found, but less pronounced structures revealed by geophysical shooting have been proved productive by the discovery at Pickens. Several such prospects have not yet been satisfactorily tested.

The leasing wave has extended east from Mississippi into South and West Alabama, and may extend into Florida and Georgia. The Warrior or North-West Alabama basin, which extends into North-East Mississippi, has producing possibilities in the Palæozoic. Outcrops show asphalt. Gas shows have been found in the upper beds in Southern Alabama.

Tinsley has three producing horizons and a recoverable reserve of 24,000,000 brl. is estimated, and there are possibilities of further extensions. The daily potential is estimated at 37,500 brl., but production averages 8000 brl./day. The flowing life of the field will probably be short. The main pay is the Woodruff sand at the base of the Selma Chalk; in the Eutaw is the Stevens sand, and between the two is the Perry sand.

The present Pickens production is believed to be on the north-west flank of the structure. G. D. H.

1445. Two Recent Discoveries may Signal Michigan's Comeback. W. V. Howard. *Oil Gas J.*, 15.8.40, **39** (14), 31.—The Michigan basin has axes of warping running generally north-west–south-east with some crossfolds giving highs, many of which are productive. Three Devonian limestones, the Traverse, Dundee, and Monroe, give most of the oil. The first gives its main production in the south-east. The chief oil development is in a strip about 50 ml. wide, running almost at right angles to the structural trends.

Discoveries have been made this year in N.E., S.E., N.E. section 22-19-3e in Arenac County, and S.½, S.W., S.W. section 15-19-3w in Gladwin County. The first is on a trend running through Adams pool, 1 ml. to the south-east, and the second is on a trend traversing the north end of the Buckeye field, about 12 ml. to the south-east.

Since 1924 Michigan has given about 191,869,000 brl. of oil, and 110,663,000 brl. have been obtained since the beginning of 1937. The main production is from the Allegan–Van Buren district in the south-west, the Walker field near Grand Rapids, the Mount Pleasant district in the centre of the state, and the Freeman–Redding or Temple field in Clare County. G. D. H.

Geophysics.

1446. Advancements Continue to be Made in Geophysical Field. Anon. *Oil Wkly*, 23.9.40, **99** (3), 50.—In the seismograph field there has been instrumental development, but the outstanding advances are due to a better appreciation of the geological problem in hand—*i.e.*, to map low dip structures and to solve fault problems. There has been greater attention to field and calculation technique. Good reflections are being obtained from depths out of reach of the drill. On the Gulf Coast there are excellent reflections below 15,000 ft., and in California, with reflections down to 40,000 ft., mapping at 20,000–26,000 ft. is common. Effective receipt of these deep reflections requires a different choice of frequency discrimination from that in ordinary use. Automatic volume control is an important factor. A more daring interpretation of data has yielded several fields on the Gulf Coast in old producing districts.

Gravity meters are in extensive use for reconnaissance. A good average for current work is one to three stations per square mile, and it is common to cover thirty stations per day, at 4$ to 9$ per station. The instruments have an accuracy of ± 0·02 milligal, although most surveys are made to only 0·05 milligal. Gravity meters have been built for use under water. The torsion balance is still used for detailed work, and is valuable on prospects which are not resolvable seismically.

Soil analyses have been developed more and search for petroleum hydrocarbons, secondary products from these or the modifications of organic matter of local origin,

and local abnormal concentrations of inorganic matter in the soil. Geochemical well logs are also being made.

The magnetometer is still used for determining the structure of magnetizable zones down to 20,000 ft. Electrical transient measurements are said to be of value, and gamma ray well logging has been introduced. G. D. H.

Drilling.

1447.* Well Saved by Side-Tracking Upper Fish to Catch Lower. T. P. Sanders. *Oil Gas J.*, 29.8.40, **39** (16), 47.—A short discussion of a new type of fishing job is given, where above a fish consisting of the bit, drill-collar, and a portion of drill-pipe, another was stuck consisting of wash-pipe. The method used to save the well was to side-track the hole and yet drill sufficiently near it so as to enter it again in the space between the upper fish and the lower one. Details of the steps taken are given.

The hole was reamed above the lower fish and an overshot was used to lift the lower fish through the 72 ft. of side-tracked hole. The hole was completed, and no difficulty was encountered in running casing.

A diagram illustrates this unusual process. A. H. N.

1448.* Steel-Pit Partitions. H. F. Simons. *Oil Gas J.*, 29.8.40, **39** (16), 48.—The fact that in many Illinois fields a rotary rig will drill at least one well per week has caused a premium to be placed on any method which will save time in rigging up and which will reduce the costs per well. Hence steel-pits have been developed which are quickly and easily installed and removed as required. Steel partitions are used in many other pits. With steel partitions, it is only necessary to dig a recess into the pit wall deep enough to allow the partition to be slid into place. The dimensions and other details of these partitions are given. A. H. N.

1449.* Fast Drilling Time in 12,000-ft. Wildcat. N. Williams. *Oil Gas J.*, 5.9.40, **39** (17), 17.—A 12,000-ft. wildcat well was drilled and completed in 68 days from the starting of rigging up. This time includes 17 days for casing and cement time, running of various coring, and other well surveys, leaving 51 days' actual drilling time.

Details of the drilling programme and equipment are given. A. H. N.

1450.* Use of Casing Mill for Multiple Sand Completions in Old Wells. H. F. Simons. *Oil Gas J.*, 5.9.40, **39** (17), 51.—The first well drilled in a field may show no oil in the shallow formations and find good productions in lower sands. Careful examination, however, of drill cuttings on subsequent wells may reveal that one or more good producing horizons were missed above the discovery horizon. The upper formations would, in these cases, be cased off in the older wells. To test for and produce oil from these cased-off sands, a tool has been developed to cut away the steel casing opposite the upper pay sands, thus permitting multiple sand production with a substantial saving in costs of drilling, casing, tubing, and equipping another well.

The tool is a special type mill with one or more sets of cutters which can be applied successively as the cutting operation progresses. Each cutter has five blades of a special alloy steel designed to cut the hardest casing. Mud is used as the circulating medium. Full details of the cutting operation are given.

The cost of cutting varies with each case, but it is generally moderate. A. H. N.

1451.* Mast-Type Derrick Used on Deep Coastal Test. N. Williams. *Oil Gas J.*, 12.9.40, **39** (18), 46–47.—At a wildcat well drilled in Coastal Louisiana a 129-ft. cantilever-type mast and specially designed substructure were used. Capacity of the mast is rated at 10,000 ft., and it appears that the mast is the largest ever built. In keeping with rigs used for slim-hole exploratory drilling it is designed to speed and facilitate moving, drilling, and setting up or dismantling.

The wildcat well drilled by this unit was abandoned at a depth of 9200 ft. The well drilled 9¾-in. open hole from 1435 ft., where 10¾-in. surface casing was cemented. More than 800 ft. of core were taken, all with a conventional core barrel.

The substructure incorporates features of portability, but is of full 8-ft. height, permitting installation of standard blow-out preventers and well-control assemblies below the derrick floor. Combining engine foundations with the substructure as a single unit, it is 45½ ft. long, exclusive of pump base, with an overall width of 18 ft. 2 in.

Details of equipment and mast are given. A. H. N.

1452.* Smaller-Diameter Holes Cut Deep-Drilling Costs. Anon. *Oil Wkly*, 2.9.40, **98** (13), 15–18).—Drilling of small holes has not been accompanied by the expected reduction of drilling time. Material costs have been reduced appreciably, but the drilling time has been longer in slim holes than in the larger holes. The latter fact has been caused largely by mechanical factors, but it is believed that drilling time in slim holes will gradually approach that in larger holes.

Details of slim-hole drilling programmes are given.

Because of the small diameter of the oil strings used in slim holes, all footage is made before running the casing. The casing is cemented well off bottom, however, above the oil zone. (Details are included in the description.) A new open-hole record was established recently when 11,800 ft. of uncased formation was penetrated. Much less casing is being run per foot of hole drilled than was run six years ago.

Rotating speeds are usually around 200–400 r.p.m., with some attaining a maximum of 500 r.p.m. No desire to use excessively high speeds is evidenced.

Use of an oil-base mud while drilling producing formations is a new California practice, which is still in the experimental stage. Mineral seal or absorption oil is used as a base for one drilling fluid of this type, but experiments have been carried out with asphalt as a base. Lamp-black and 300-mesh limestone are added for colloidal and weighting purposes, respectively. Derrick men usually object to its use because "it is messy to handle." Chemical treatment of mud is discussed.

A study is made of the desirability and method of keeping the hole straight on the usual lines—*i.e.*, of keeping the drill string in tension above the collar. Figures, however, are given for practical purposes. A. H. N.

1453.* Drilling the Lucas Gusher. A. W. Hamill. *Oil Wkly*, 2.9.40, **98** (13), 35.—An historical sketch of the drilling of Spindletop's discovery well in 1900–1901 is given by the driller. It was this well which started the industry on its rapid rise to present world prominence, although the original Drake well is recognized as the most important discovery in the oil industry. A. H. N.

1454.* Lost Circulation in Illinois Devonian Drilling. Anon. *Oil Wkly*, 9.9.40, **99** (1), 12–15.—The chief difficulty when drilling below 2400 ft. at Salem is that when the weight of the mud exceeds 9½ lb./gal., the column weight plus the pump pressure at the ports of the bit will overcome the formation tension and result in the loss of mud in the permeable formations being penetrated. The objective to be attained becomes to hold the viscosity at such a point that it will be most effective in plastering the walls of the hole, yet the mud remains sufficiently light in weight to obviate it being lost by excessive column pressure.

In many wells the zone of lost circulation has been sealed effectively by squeezing cement into the permeable formation. Lime slurry has also been used effectively. Both methods failed in many instances, however.

Additives which have been found very successful are now used. These are either flakes of mica or cellophane, frequently crinkled. Either additive is mixed with the mud in varying percentages, but seldom in greater quantities than 3–4% of the quantity picked up by the pump. A. H. N.

1455.* Practical Survey of Direct Mechanical Rotary Drilling Outfits. V. J. Beissinger. *Petrol. World*, August 1940, **37** (8), 31.—A brief historical review of the development of direct mechanical rotary drilling rigs using internal-combustion engines for prime movers is given at the beginning of this extensive paper.

The chief objectives of good mechanical rig design are given as: (1) portability; (2) power transmission flexibility and provision for sufficient speed variation to permit

engines to operate at optimum performance points; (3) low cost and maintenance requirements.

A discussion of multiple-engine outfits and methods of connections to be used follows. The data regarding the comparative values of driving through a reversing clutch and gear mechanism or through a chain transmission directly to the draw-works are meagre, and choice of either system is left to personal experience.

The principal economic considerations involved in the selection of mechanical drilling rig programmes are listed as: (1) location and accessibility, whether wildcat or development well; (2) fuel and water, cost and suitability; (3) completion programmes, total depth, casing, productivity, and curtailment effect; (4) materials and supplies, on hand and new purchases; (5) labour, cost and adaptability; and (6) tool rental charges, depreciation, obsolescence, repairs, and replacements. To illustrate these points a direct analysis is made of a typical case of an 11,168-ft. wildcat drilled in the Wheeler Ridge area, of another wildcat well in the Coalinga area, of a routine development well in a third area, and of others in less detail.

Based on the consideration of six examples of heavy and light duty mechanical outfit performance data, and on the writer's acquaintance with similar factual data for a number of other such jobs, the economy of operation peculiar to this type of rig appears to be well established.

The chief disadvantages of such rigs when compared to steam-driven rigs appear to be: (1) Steam power is more flexible. (2) I.C.E. must be geared to specific load limits. (3) Power-driven slush pumps are more costly, heavier, and subject to gear strength limitations. (4) Reverse gear and clutch mechanisms are subject to frequent adjustments. (5) More shock is experienced in drilling with such outfits than when using steam.

The rest of the paper describes the efforts made to minimize these disadvantages.

A. H. N.

1456.* Bulk Cementing. Anon. *Petrol. World.* August 1940, **37** (8), 47.—This system is simply a method of transporting cement from specially designed bins to the well in an efficient manner. It consists essentially of a railroad siding and a series of storage bins to store various brands and types of cement and of mechanical equipment to unload cement in bulk from freight cars to storage bins. From the bins the cement is conveyed to a "weight-batcher," from which it is unloaded into transport units which convey it to the wells. At the well, screw conveyors move the cement from the transport unit to the mixer or to smaller bins. Four hundred sacks of cement were used to cement 3020 ft. of 8¼-in. casing by this method, and the cement was mixed in 18 min.

Although the initial cost of the system is high, it appears that it offers the advantages of eliminating spoilage of cement by weather, breakages of sacks in transport, waste of cement while mixing, and assures uniform feeding of cement into the mixer.

A. H. N.

1457.* Importance of Drill-Pipe String in California Deep Drilling. W. A. Sawdon. *Petrol. Engr*, September 1940, **11** (13), 23–26.—The high degree of efficiency attained in deep-drilling operations in California is stated to have been influenced to a considerable extent by the attention paid to the drilling string and its component parts. Advanced metallurgical work has supplied material of adequate strength and hardness; design has utilized the material for effective performance and long life, and drilling technique has applied the designs to consistently successful application in meeting the conditions encountered. These various points are illustrated.

Where higher rotating speeds than 400 r.p.m. are used, $5\frac{9}{16}$-in. drill-pipe is found most desirable, with 4½-in. drill-pipe being the smallest size used for comparatively high speeds up to 400 r.p.m.

Large volumes of circulating fluid are necessary for deep drilling operations, and although high pressures are expected, it is desirable to keep the pressure down as much as possible. Large-capacity pumps are used, but the pumping rate of the circulating fluid probably never exceeds 1000 gals./min. below 10,000 ft. The average rate is between 700 and 800 gals./min.

Details of the drill-pipe and its joints and collars as well as the drill-collar are studied from a point of view of the stresses generated in drilling deep wells. A. H. N.

1458.* Hydraulic Torque Converter Used on Illinois Drilling Rig. H. L. Flood. *Petrol. Engr*, September 1940, **11** (13), 31–32.—The important element that rendered possible the change from steam to internal-combustion engines at reasonable cost was the hydraulic torque converter that was incorporated into the drive between the engine and the draw-works.

The torque converter is essentially a hydraulic chamber comprising a centrifugal pump and a reaction turbine. In the impeller or the pump, as the fluid velocity increases the fluid absorbs kinetic energy, and thereby imposes a corresponding load on the engine or driving-member. In the runner or turbine, due to loss of rotational velocity as the fluid is forced to the inside, kinetic energy is released and becomes available to the output shaft.

The capacity of the converter is based on hydraulic principles, in accordance with which the horse-power is proportional to the cube of the speed, and the torque is proportional to the square of the speed. Both horse-power and torque are in proportion to the fifth power of the diameter. Similarly, the power absorbed by the impeller is proportional to the cube of its speed.

Characteristics of torque converter, giving efficiency, output torque, and engine torque against speed, are reproduced. The efficiency curves are the usual ones showing maxima at certain speeds. A. H. N.

1459.* Temperature Log Reveals Gas–Oil Contact Plane. W. A. Sawdon. *Petrol. Engr*, September 1940, **11** (13), 83–84.—Amongst the reasons for and applications of geothermal surveys undertaken during the last 2 years have been the location of the top of cement behind casing, detection of points of entry of gas or water, and the determination of other points at which conditions cause slight change of temperature. Surveys have been made in flowing, pumping and shut-in wells, in drilling wells, and also in wells ready for completion.

Such a survey revealed, recently, the location of the point of contact between gas- and oil-bearing strata of a producing zone by temperature indication, with the consequent shutting off of the upper gas so indicated to conserve gas by reducing gas–oil ratio. Although other means have previously been used for this purpose, the speed at which the survey was made and the accuracy with which other determinations were checked render this method of value.

The equipment consists of a recording thermometer run on a piano wire with a conventional measuring-line hoist. The temperature record is made on film moving at constant speed, which provides synchronization with depth measurements at any time by means of a stop watch started at the same time as the instrument.

A. H. N.

1460.* New Fast-Setting Cement. R. K. Henderson. *Petrol. Engr*, September 1940, **11** (13), 93–94.—A new calcium sulphate cement is being used to advantage in special cases where other types are not readily adaptable. This cement is composed of 98% dehydrated calcium sulphate, to which have been added other compounds to control the setting time. Setting is accomplished through the hydration of the material to a dense, hard, interlocking, crystalline structure. Setting time is standardized to four periods: 30, 60, 120, and 180 min.

Setting of the material results in volumetric expansion, thus producing a very tight bond to steel and adherence to the walls of the hole. The cement will set under agitation, and, when set, leaves no free water on the surface. Crushing strength of the material is approximately 2000 lb./sq. in. shortly after setting. Very little heat is developed during the setting process.

Contamination with salts, sulphates, and bicarbonates in appreciable amounts will accelerate the setting time, hence caution must be exercised in mixing and placing of this cement if the standard setting time is expected. Whenever possible a sample of the cement should be mixed with the water to be used and allowed to set, to determine the exact setting time on any job. A. H. N.

1461.* Casing Cutting Tool May Stimulate Exploitation of Cased-Off Sands in Older Fields. H. L. Flood. *Petrol. Engr*, September 1940, **11** (13), 107–108.—Two recent developments are of great potential importance in untapping formations which lie

hidden behind cemented casing strings. These are the apparatus and technique for logging geologic formations behind casing by use of gamma ray, and methods of cutting casing at any desired depth. The last development is under two main lines; the first consists of a tool which can drill laterally at any desired point in a well, cutting casing and the hardest type formation in one operation, retaining a sample intact in the hollow cutter which is retractable and can be hoisted to the surface; the second consists of perfecting a method for milling or cutting-out and completely removing steel casing over any desired length.

Operation of the milling device requires the use of rotary drill-pipe to suspend the tool, supply the rotation required, and circulate the mud to actuate the tool and remove the cuttings from the hole. Two types of cutting mills are available—a cutting-through mill for starting a window in the casing, and an expanding casing mill comprising three sets of cutter blades. After the drilling equipment is in place and ready for operation, the cutting-through mill is lowered to the point corresponding with the upper edge of the desired window. The cutter is forced outward by means of mud pressure acting on a piston which restricts the passage of mud until the cutters are completely out. A. H. N.

1462. Drilling Patents. P. W. Appleby. U.S.P. 2,212,491, 27.8.40. Appl. 29.8.39. Well-washing device in combination with a rotary drilling apparatus.

H. W. Evans. U.S.P. 2,212,594, 27.8.40. Appl. 6.2.39. Offset drilling tool with a wall engaging means.

C. H. Black. U.S.P. 2,212,727, 27.8.40. Appl. 12.10.39. Drill bit with conical toothed cutters.

H. E. Chiles. U.S.P. 2,212,729, 27.8.40. Appl. 10.11.39. Drill bit with conical cutters.

V. W. David. U.S.P. 2,213,038, 27.8.40. Appl. 27.6.38. Formation sealing composition made of a colloidal jell of clay of the Frazier Mountain and Mojave types combined with cement, calcium chloride, unslaked lime, bentonite, litharge, and caustic which hardens on the addition of water into an impervious mass.

V. W. David. U.S.P. 2,213,038, 27.8.40. Appl. 14.11.38. Water shut-off method and composition for wells.

D. H. Reed. U.S.P. 2,213,049, 27.8.40. Appl. 9.5.38. Compensating outside pipe-cutter with releasable cutter arms.

J. T. Hayward. U.S.P. 2,213,138, 27.8.40. Appl. 1.7.39. Method and apparatus for detecting oil in well-drilling by subjecting the returned mud to fluorescence-exciting rays to render minute oil drops visible by fluorescence and subjecting the same field to visible light ray to check presence of oil in the field.

B. P. Bishop. U.S.P. 2,214,786, 17.9.40. Appl. 15.8.38. Apparatus for logging holes while drilling, the bit being in electrical continuity with the drill stem, and used as an electrode for measuring the self potential of the strata.

D. C. Sharp, L. K. James, and R. M. Garrison. U.S.P. 2,214,799, 17.9.40. Appl. 29.11.35. Slush pump valve with a resilient closing member.

A. J. Colmerauer. U.S.P. 2,214,811, 17.9.40. Appl. 13.9.38. Liner perforator and under-reamer.

J. Mooney. U.S.P. 2,214,970, 17.9.40. Appl. 25.4.39. Combination well-driving and boring tool.

S. W. Marshall. U.S.P. 2,215,047, 17.9.40. Appl. 17.12.38. Rotary well-drilling apparatus consisting of a rotary table and bearing lugs, a roller-supporting bracket below the table.

B. S. Minor. U.S.P. 2,215,049, 17.9.40. Appl. 28.4.37. Hook for rotary well-drilling.

J. Rogoff. U.S.P. 2,215,072, 17.9.40. Appl. 25.3.39. Wire splicer.

G. Prince. U.S.P. 2,215,251, 17.9.40. Appl. 7.2.38. End protector for threadless pipe.

R. P. Fisher. U.S.P. 2,215,264, 17.9.40. Appl. 16.11.38. Rotary drill-bit with a centrally flanged shaft for mounting cutters thereon with ball bearings between cutters and flange.

C. S. Penfield and U. M. Warren. U.S.P. 2,215,377, 17.9.40. Appl. 2.5.39. Mud wiper for tubing being withdrawn from a well containing drilling fluid.

C. R. Athy. U.S.P. 2,215,494, 24.9.40. Appl. 3.12.37. Drilling bit.

J. D. Brack and L. M. York. U.S.P. 2,215,632, 24.9.40. Appl. 7.6.38. Pipe-cutting tool for inside cutting jobs, with laterally moving cutters moved by a tapered body.

J. T. Ellis. U.S.P. 2,215,638, 24.9.40. Appl. 26.5.36. Pipe cutter for cutting pipe inside wells, the cutters being fluid-operated.

G. E. Mullinix. U.S.P. 2,215,649, 24.9.40. Appl. 3.8.36. Well-pipe elevator adapted to support a pipe by its collar.

G. W. Miller. U.S.P. 2,215,710, 24.9.40. Appl. 18.7.38. Sand pump bottom containing a disc type valve.

W. F. Sheffield. U.S.P. 2,215,770, 24.9.40. Appl. 29.9.39. Drilling shaft coupling for oil well drilling shafts.

A. J. Thomas. U.S.P. 2,215,824, 24.9.40. Appl. 29.12.38. Chain wrench for pipes.

H. H. Franks. U.S.P. 2,215,920, 24.9.40. Appl. 12.8.38. Derrick structure adapted for portability and having a mobile base.

J. W. Hornbrook. U.S.P. 2,215,928, 24.9.40. Appl. 19.12.36. Drilling apparatus of a portable mast type; rotary system.

P. A. Williams. U.S.P. 2,215,948, 24.9.40. Appl. 23.1.39. Drilling tool.

I. N. Clark. U.S.P. 2,216,067, 24.9.40. Appl. 12.7.39. Blasting bridge for oil wells comprising an expansible, longitudinally collapsible closed pre-filled chambered member having a gravity actuated fluid material for expanding the chambered member into engagement with a well wall. A. H. N.

Production.

1483. Study of Brine-Disposal Systems in Illinois Oilfields. S. S. Taylor, W. C. Holliman and C. J. Wilhelm. *U.S. Bur. Mines. Report of Investigations* No. 3534. August 1940.—The problem of brine in the oilfields of Illinois has recently attracted a great deal of attention, and accordingly the Bureau of Mines has made a general survey of disposal systems available and their use in this State. Where sufficient surface water is available to reduce the salt content of oilfield brines to a negligible amount, large volumes of brine can be discharged into surface streams. As a rule, however, this method is suitable only in cases where a relatively small volume of brine is produced.

Another method adaptable to several oilfields in Illinois is to return the brine to subsurface formations already containing brine. Subsurface disposal of this character cannot, however, be universally employed, since in certain fields no formation pervious enough for brine injection has been found.

Certain brines require chemical stabilization before injection into subsurface formations, because of the volume or type of brine or the characteristics of the disposal formation, but investigations are not yet sufficiently far advanced to give a definite ruling on this point.

The report, in addition to embodying the results of a number of chemical tests, includes some valuable suggestions and criticisms of brine-disposal systems at present in use in the State. In certain cases it was found that wells had an insufficient intake capacity to indicate that a large volume of brine could ultimately be injected into the formation. The suggestion is made that other formations should be tested for injection purposes.

It is recommended that brine-conditioning and disposal systems should be kept under continuous observation, so that with changing producing conditions adjustments can be made in brine treatment. The design of brine-disposal systems should moreover be formulated only after detailed studies of chemical characteristics and volumes of the brine to be injected, also of the brine in the disposal formation, etc.

Summarily it is concluded that no general system of brine conditioning and disposal can be recommended for all oil-producing areas in the State, owing to the widely varying chemical characteristics of the brines produced and the different characteristics of brine-disposal formations. H. B. M.

1464.* Capillary Behaviour in Porous Solids. M. C. Leverett. *Petrol. Tech.*, August 1940, A.I.M.M.E. Tech. Pub. No. 1223, 1–17.—The static equilibrium vertical distribution of fluids of different densities in porous solids is discussed largely from a thermodynamic standpoint. The concept of a characteristic distribution of two-fluid curvatures with water saturation is suggested. This curvature–saturation relationship for clean unconsolidated sands was examined experimentally for imbibition and drainage and hysteresis demonstrated. The extent of the two-fluid interfacial surface area was shown to be determinable from thermodynamic considerations of the curvature–saturation relationship. The "hydratable" clayey matter in natural sandstones strongly affects the curvature–saturation function, and may be the cause of large "connate" water saturations in some reservoir rocks.

The distribution of oil, gas, and water was calculated for a uniform unconsolidated sand.

The concepts developed are applied briefly to problems in the flow of mixtures of immiscible fluids in porous media, with emphasis on the proper accounting for the effects of capillarity on such flow. The existence of a *boundary effect*, characteristic of any discontinuity in the capillary properties of the solid medium, is pointed out, and the importance of adequately allowing for its influence in the interpretation of data from small-scale experiments is stressed. G. D. H.

1465. Pressure Distribution about a Slotted Liner in a Producing Oil Well. F. G. Miller. *Petrol. Tech.*, August 1940, A.I.M.M.E. Tech. Pub. No. 1222, 1–15. *Petrol. Engr*, September 1940, **11** (13), 109.—The presence of a slotted liner in a well disturbs the simple radial pressure distribution about the well by increasing the pressure gradient near it by a convergence factor and a sand-bridging factor. This problem was examined mathematically. Experimental work was also carried out using fluid flow through a sand apparatus made geometrically similar to the well problem, and also with an electrolytic conduction model simulating the same condition.

It was found that the additional pressure loss resulting from the formation of a sand bridge over a rectangular slot becomes small, nil, or even negative if the slot width used is equivalent to at least the grain size at the 10-percentile size of the sand, taken from its sieve-analysis curve. The pressure loss resulting from the bridge increases markedly when the slot width is reduced. The additional pressure loss resulting from the convergence of the streamlines in the sand near a slot decreases as the slot length is increased. Experimental results show that the additional pressure drop per unit rate of flow due to a slot of length equal to the sand thickness is about one-third the loss for a slot of the same width, but only one-half the length, placed so that its centre is midway between the upper and lower horizons defining the oil sand, if the effect of bridging is neglected. Increasing the width of the slots without increasing the length does not reduce the convergence loss greatly.

The pressure loss due to the slots themselves, which is similar to the pressure drop across an orifice in pipe-line flow of liquids, is small compared with the corresponding loss that would occur in the sand near the slot. A slotted liner does not affect normal flow conditions in the sand beyond a distance, measured from the well axis, of three times the well radius. G. D. H.

1466.* Major Economies Result from Adoption of Twenty-Acre Well-Spacing. J. A. Kornfeld. *Oil Wkly*, 2.9.40, **98** (13), 10–14.—Twenty-acre spacing is the pattern employed in more than one-fith of the proratable oil wells on production on the Central Kansas Uplift. A saving of over $16,000,000 in development costs are estimated to have resulted from the adoption of this pattern. Further, it is expected that this pattern will result in retarded encroachment of edge-water, thus achieving a greater recovery/acre of the original reservoir reserves.

Many factors are responsible for this relatively wide well-spacing programme, amongst which are shrinkage of market due to loss of out-of-State demand; low per well allowable; high cost of production; present ability to drain large areas, due to universal use of acid in large doses; forced development of leases due to short-term expiration, to protection from drainage, and to maintaining drilling density with offset leases; low withdrawal rate from principally lime reservoirs; and hydrostatic head being propelling force with little or no gas drive.

From an engineering standpoint, well-spacing conditions in Western Kansas are related to three objectives: First, to secure the most efficient development with the least number of wells—*i.e.*, at the lowest cost/brl. of reserves. Secondly, to achieve a full, uniform development of the entire property through the most efficient well-spacing pattern for that type of reservoir. Thirdly, to delay the rate of water encroachment, through the rate of property development and the rate of withdrawals.

The legal aspects of well-spacing and proration are discussed. A. H. N.

1467.* Conventional Pumping Proves Economical in Slant Holes. Anon. *Oil Wkly*, 9.9.40, **99** (1), 23.—Directionally drilled oil wells are being pumped at reasonable costs in the Huntington Beach field, California. Many of these intentionally deflected holes drift more than 45 degrees from the vertical, and extreme drift angles of more than 60 degrees have been attained in wells being pumped successfully with conventional rods and tubing. About 115 deflected wells are on the pump.

Lifting costs in the various wells range from 8 to 40 cents/brl., but operators are not in agreement about items included in the lifting costs.

A certain well has a horizontal drift of 3200 ft., a total depth of 5694 ft., and an actual vertical depth of 4250 ft. This well has been on the pump about 2 years, and has given little trouble, except immediately after completion. Rod and sand troubles have been overcome. Spiral rod guides are used to check rod and tubing wear. Most of the wear is near bottom, due probably to settling of dirt and sand.

Many rod failures have been traced to severe wear on the couplings.

Mechanical action of the submerged pumps has not been seriously affected by inclination of the holes, where other factors are favourable.

Details of the type of wear observed on various parts and data of production are given and illustrated. A. H. N.

1468.* New Potential Method Uses Data Obtained at the Surface. J. H. Page. *Oil Wkly*, 16.9.40, **99** (2), 17.—In measuring productivity indices, the amount of liquid a well will produce per unit drop in bottom-hole pressure is determined. The pressure is either measured directly by a bomb at the bottom or estimated from the height of the fluid level, using a wave-impulse instrument. To calculate the pressure from the height of the liquid column a knowledge of the mean density of the liquid column as well as that of superincumbant gas column is essential.

In this new method the density of the liquid column is measured in the following manner. A recording pressure gauge is attached to the casing-head, which is closed-in during the test. If sufficient gas is produced, a regulator is placed on the casing-head outlet and set to maintain the required back-pressure for the first pumping rate. When both pressure and hourly production are stabilized, the fluid level is determined by an impulse method.

After production during 3 hrs. of stabilization has been pumped and gauged, the regulator setting is changed and pressure stabilization is again reached, keeping the production rate constant. This change in casing-head pressure is necessary in order to effect a difference in pressure on the fluid surface. The density of the oil column is obtained by observing the distance which the fluid surface has been depressed by the change in pressure. When the fluid density has been measured for the first production period, the pump speed is changed and a second stabilization period is started.

Three stabilization periods are used as in other fluid-level tests. Bottom-hole pressures are computed by adding together the recorded casing-head pressure, the weight of the gas column above the liquid, and the weight of the liquid column above the producing formation. The specific gravity of the gas in the annulus between casing and tubing is calculated from the speed with which wave-impulses reach the well head after being reflected by the surface of the liquid in the well.

The well potential is computed by first averaging two indices, taken as the ratio of the increment in production rate to the increment in bottom-hole pressure; the average index is next multiplied by the bottom-hole pressure at the lower rate. Adding this product to the lower rate gives the potential. A. H. N.

1469.* Dyes Aid in Tracing Water. Anon. *Oil Wkly*, 16.9.40, **99** (2), 18.—To make it possible for future drillers to determine whether water encountered in a pay-sand is coming from a previously plugged well, operators are using dyes. The "detector" is made of 30–40 oz. of red or purple dyes with sufficient warm water to form a thick paste. This mass is packed into a waxed paper container, which is weighted and dropped down the hole. The casing is pulled out and the hole plugged in the normal manner.

The paper is soon ruptured, and any moving body of water will tend to take the dye in the stream. By placing detectors of different colours in certain wells, and by keeping such locations carefully preserved on a map, it is possible to estimate dips and high-spots in a sand, and also to prove the general direction in which the sand is draining as well as to find the source of contaminating waters in future wells.

A. H. N.

1470.* More Efficient Practices Used to Produce Gas Wells on Gulf. N. Williams. *Oil Gas J.*, 29.8.40, **39** (16), 43–44.—In the production of high-pressure gas wells which are not of the distillate type, control of the pressure drop is a major factor in the efficient recovery of liquid content of the gas. This control involves reduction of pressures without causing freezing in the gas lines and separators, and simultaneously without applying too much heat to the gas to allow easy separation of gas and liquid.

Bottom-hole chokes have not proved successful because of continuous need for changing the size of the orifice. The most popular system is one where just sufficient heat is imparted to the gases before expansion to keep the temperature on the exit side constant. The regulators are placed, in this system, on the discharge side of the heater coil.

A discussion of heaters and regulators used on the Gulf Coast for such systems shows continual progress in design of the heaters and regulators. A. H. N.

1471.* Co-operative Repressuring in Louisiana Field. G. Weber. *Oil Gas J.*, 5.9.40, **39** (17), 32.—The advantages gained from repressuring are illustrated by this study of the Homer field in North Louisiana. Current production averages 2400 brl./day, approximately 50% above the estimated production under an ordinary depletion programme. In addition to the more rapid pay-out, the increased production represents an increase in recoverable oil, by extending the field's economic life for several years. Reduction of vacuum has shown definite returns in the relatively fewer clean-out jobs and lower field-operating costs.

The paper includes an historical account of the development of the repressuring project, a study of the operations and practices involved, gas–oil ratio studies, and processing of the gas produced.

The principal operating problem is controlling the gas–oil ratio. In most cases, this control is achieved by reducing the orifice in the gas line from the well showing increased gas production. A. H. N.

1472.* Unfavourable Pumping Speeds May Cause Excessive Sucker-Rod Breakage. T. P. Sanders. *Oil Gas J.*, 5.9.40, **39** (17), 37.—An upper limit to the number of strokes per minute in pumping wells is known to exist, but an unfavourable pumping speed may also occur at lower values than this upper limit, where failure of sucker-rods may occur due to vibrations. When a sudden stress is applied to the rods, that stress is transmitted to the other end of the rod in the form of a longitudinal

wave. The frequency of the wave was shown to be equal to the velocity of stress transmission divided by 4 times the length of the rod string. Thus, frequency = 237,000/length of rods.

In designing pumping equipment, speeds which give rise to severe vibrational stresses due to synchronous vibrations of the first order should be avoided. A chart is given to assist in choosing safe speeds for various depths. However, only a dynamometer test would be a certain way of choosing optimum values of speeds.

A. H. N.

1473.* Small Generating Plant for Pumping. H. F. Simons. *Oil Gas J.*, 12.9.40, **39** (18), 65–66. Efficient pumping of shallow oil wells by electricity is being accomplished through a carefully designed system of a small generating plant supplying powder to forty-six producing wells and to a pump at a salt-water disposal well. Approximately 1000 brl. of fluid are lifted daily by the pump. Loads of the individual wells vary widely, and the length of the stroke, the number of strokes/min., and the time the well is on the pump differ from well to well, due to characteristics of the producing horizon.

Each well is equipped with an individual pumping unit driven by an electric motor. Generally the motors are of 220–240 volt, 8·1–4·05 amp., 3-phase, 3-h.p., 60-cycle, 1675-r.p.m. induction-type, capable of running continuously with a 50° temperature rise. The generating plant is as centrally located as possible to reduce the length of the transmission lines.

Certain details of the equipment, internal-combustion engine and generator foundation and of switchboard and transmission systems used are described and illustrated.

A. H. N.

1474.* Distortion of Sucker Rods. T. P. Sanders. *Oil Gas J.*, 12.9.40, **39** (18), 66.—In a short note on distortion of sucker rods when pulling stuck pumps, it is pointed out that the force required should be within the limits of the sucker-rod's capacity. The best available practice to avoid sucker-rod distortion due to excessive pulling forces is to use a weight indicator on rod-and-tubing pulling units. Another method may be used when weight indicators are not available, *i.e.*, to limit the rod stretch. A chart gives the maximum allowable stretch for rods of various lengths and yield points.

The method consists of raising the elevators to take up the slack in the rods and tying a marker on to the string. Further force is applied and the stretch is noted. If the stretch is near the maximum allowable, then it will not be safe to continue, and a tubing job is indicated.

A. H. N.

1475.* Deepening and Completing a Well in the Lisbon Field, Louisiana. Pt. 8. P. D. Torrey and F. H. Miller. *Petrol. Engr*, September 1940, **11** (13), 124.—This is the concluding part of the long paper prepared by the authors to describe every detail of deepening a certain well. In this part methods are suggested of increasing oil recovery from this well based on information gained from tests described in previous parts. Gas-repressuring and pressure maintenance are discussed.

In the summary it is concluded that in this particular field pressure maintenance can only be accomplished economically if the several operators in the field co-operated. Several independent plants would serve merely to increase the cost, and would not improve the efficiency of the operation. Losses in recovery due to non-employment of pressure maintenance are made clear, but the full study of the economics of repressuring cannot be given, as the data are too meagre.

A. H. N.

1476. Repair of Oil Wells. B. L. Astiz. *Bol. Inform. Petroleras*, May 1940, XVII (189), 19–27.—This is a description of the methods adopted for the repair of oil wells, with special reference to the conditions obtaining in the field at Comodoro Rivadavia. A number of pipe filters are illustrated.

H. I. L.

1477. Some Aspects of the Use of Mechanically-Operated Pumps for Raising the Oil in the Comodoro Rivadavia Oilfield. M. Soifer. *Bol. Inform. Petroleras*, May 1940, XVII (189), 28–35.—The author points out that little has been published concerning the conditions affecting mechanically-operated pumps. The bulk of the pumps at

Comodoro Rivadavia are of this description, and the relatively high viscosity of the petroleum raised introduces features of interest. Among the points discussed is the effect of acceleration of the pump and of the petroleum on the maximum stress that can be borne by the pump rods, and also the effect of viscosity. The use and advantages of the "insertable" type of pump are considered in detail and various improvements are dealt with. H. I. L.

1478. Production Patents. A. J. Hughes. U.S.P. 2,212,604, 27.8.40. Appl. 12.11.37. Apparatus for depth measurement by echo reception methods.

E. J. Roe. U.S.P. 2,212,619, 27.8.40. Appl. 4.3.37. Well-packing device.

B. W. McCune. U.S.P. 2,212,784, 27.8.40. Appl. 24.2.40. Well-casing perforation cleaner.

R. Wiken. U.S.P. 2,212,909, 27.8.40. Appl. 24.1.38. Power unit for multiple oil wells comprising an eccentric rotating on a vertical axis.

C. P. Stauffer. U.S.P. 2,213,022, 27.8.40. Appl. 31.10.38. Repair clamp for pipes.

T. B. Wayne. U.S.P. 2,214,783 and 2,214,784, 17.9.40. Appl. 20.7.38 and 29.7.38, respectively. Processes and reagents for resolving emulsions of petroleum.

W. J. Dunlap. U.S.P. 2,214,956, 17.9.40. Appl. 14.9.38. Plunger controlled valve for oil well pumps.

J. S. Wylie. U.S.P. 2,214,982, 17.9.40. Appl. 16.6.38. Pipe cleaner containing an elongated helical spring, and a number of scraping blades secured to the spring at various radial positions.

G. S. Shupe. U.S.P. 2,215,164, 17.9.40. Appl. 30.3.39. Pump with latches to remove the cylinder when required.

J. Sutherlin and F. I. McConnell. U.S.P. 2,215,487, 24.9.40. Appl. 9.3.38. Treatment of wells by acid where acid is forced under pressure and maintained until permeability of formation reaches a maximum, when the pressure is released and acid is withdrawn and treatment repeated.

A. Hollander. U.S.P. 2,215,505, 24.9.40. Appl. 13.1.38. Variable capacity pumping apparatus for deep wells with a submersible electric motor and pump unit.

R. R. MacGregor. U.S.P. 2,215,514, 24.9.40. Appl. 25.7.38. Well device for cleaning well tubing, casing, liners, and the like, comprising brushes on mandrel.

A. G. Miller. U.S.P. 2,215,558, 24.9.40. Appl. 29.12.38. Deep well pump with air in a compression chamber to act as a cushion.

C. O. Tullberg and R. D. Frampton. U.S.P. 2,215,599, 24.9.40. Appl. 29.8.39. Tubing bleeder for oil wells.

R. I. Brown. U.S.P. 2,215,913, 24.9.40. Appl. 4.10.38. Method and apparatus for operating wells whereby a string of casing consisting of alternating sections of ordinary casing and others of drillable casings is landed, the latter sections set against producing horizons and drilled subsequently.

L. A. Layne. U.S.P. 2,216,037, 24.9.40. Appl. 27.12.37. Means and method of gravelling wells consisting of a gravelling assembly of a smaller diameter than casing in the well and a gravelling tool.

L. A. Layne. U.S.P. 2,216,038, 24.9.40. Appl. 9.2.39. Gravel dump bucket and method of depositing granular material in a well bore around a strainer element.
A. H. N.

Hydrogenation.

1479. Patents on Hydrogenation. E.I. Du Pont de Nemours & Co. E.P. 526,495, 19.9.40. Appl. 17.3.39. Manufacture of hexamethylene imine by catalytically hydrogenating adiponitrile in the vapour phase in the presence of an excess of ammonia and of hydrogen.

J. C. Morrell and A. U. Grosse. U.S.P. 2,212,034, 20.8.40. Appl. 30.4.38. Treatment of aliphatic hydrocarbons by contacting them under dehydrogenating conditions with an alumina–silica composite supporting a minor proportion of an oxide of tin.

J. C. Morrell and A. U. Grosse. U.S.P. 2,212,035, 20.8.40. Appl. 30.4.38. Production of aromatic hydrocarbons from aliphatic hydrocarbons of at least six carbon atoms in straight-chain arrangement by subjecting the latter to dehydrogenation and cyclizing conditions in the presence of an alumina–silica composite supporting a minor amount of an oxide of tin.

V. Ipatieff and R. E. Schaad. U.S.P. 2,214,463, 10.9.40. Appl. 30.4.37. Production of more valuable products from butene trimers by subjecting them to destructive hydrogenation under conditions conducive to the formation of octanes by depolymerization and hydrogenation of the trimers. H. B. M.

Polymerization.

1480.* Production of Aviation Spirit by Alcoholization and by Polymerization of "Cracking" Gases in the Liquid Phase. A. Pinilla. *Bol. Inform. Petroleras*, May 1940, XVII (189), 5–19.—This is a detailed description of the process in which sulphuric acid is used as the condensing agent and where two types of gas are used—namely, a gas which is mainly *iso*butane and another which consists predominantly of butane. A mixture of these with ordinary high-grade petrol results in a high-class aviation spirit. H. I. L.

Synthetic Products.

1481. Patents on Synthetic Products. J. G. Fife. E.P. 525,403, 28.8.40. Appl. 7.1.39. Manufacture of refined products from hydrocarbon mixtures by separating the liquid mixture into fractions having different compositions by means of an extraction process involving the use of a solvent consisting of antimony trichloride with or without the addition of other substances.

A. Carpmael. E.P. 525,673, 2.9.40. Appl. 25.2.39. Manufacture of fatty aromatic monochloromethyl compounds. Fatty aromatic hydrocarbons which contain one or more alkyl residues with more than two carbon atoms are brought into reaction in the presence of zinc chloride or concentrated sulphuric acid with hydrogen chloride and an excess of paraformaldehyde.

Stafford Allen & Sons. E.P. 525,705, 3.9.40. Appl. 27.2.39. Preparation of propenylbenzene derivatives from alkylbenzene derivatives capable of isomerization by heating with caustic alkali in which a glycol or polyglycol is used as a diluent for the heated caustic alkali.

I.G. Farbenindustrie A.G. E.P. 525,733, 3.9.40. Appl. 27.2.39. Manufacture of synthetic rubber-like materials by subjecting butadienes 1 : 3 to co-polymerization in aqueous emulsion with other polymerizable compounds. The polymerization is effected in the presence of such tertiary amines as are soluble in at least one of the polymerizable compounds.

Compagnie Française de Raffinage. E.P. 526,084, 10.9.40. Appl. 9.3.38. Process for the synthetic preparation of hydrocarbons to obtain fuels having a high anti-knocking power. Gaseous *iso*butylene is converted into *iso*-octane by a series of reactions—*i.e.*, hydration by means of sulphuric acid, for forming tertiary butyl alcohol; dehydration and polymerization of this tertiary butyl alcohol to produce di*iso*butylene; and hydrogenation of the latter.

H. E. Potts. E.P. 526,465, 18.9.40. Appl. 17.3.39. Improvement in the production of hydrocarbons with more than one carbon atom in the molecule by conversion of carbon monoxide with hydrogen. The improvement consists in converting a gas mixture containing 2 parts or less of hydrogen to 1 part of carbon monoxide and alternately a gas mixture richer in hydrogen, thereby reactivating the catalyst.

V. Komarewsky. U.S.P. 2,212,026, 20.8.40. Appl. 31.12.36. Conversion of aliphatic hydrocarbons into cyclic hydrocarbons by subjecting them at elevated temperatures and atmospheric pressures to contact with a catalyst consisting of a mixture of aluminium oxide and metallic nickel.

J. F. Clausen. U.S.P. 2,212,112, 20.8.40. Appl. 26.11.38. Method of increasing the cyclic hydrocarbon content of a hydrocarbon mixture boiling within the gasoline range and containing a substantial amount of aliphatic hydrocarbons of at least six carbon atoms. The hydrocarbon mixture is contacted with a preformed heavy metal salt of an acid of the class consisting of molybdic and tungstic acids at a temperature between 400° and 600° C.

C. M. Loane. U.S.P. 2,212,644, 27.8.40. Appl. 5.12.36. Preparation of a new composition of matter consisting of white oil and from 1 to 50 parts of an acid selected from the group consisting of sulphuric acid, chlor-sulphonic acid, and a mono-alkyl sulphuric acid in about one million parts of the oil.

E. Slatineanu. U.S.P. 2,213,415, 3.9.40. Appl. 15.12.36. Production of mixtures of hydrocarbons by subjecting a composition consisting of methane, at least one member of the group constituted by carbon monoxide and carbon dioxide, and at least one member of the group constituted by hydrogen and water at a temperature between 225° and 380° C. to a pressure of more than 500 atmospheres. This suffices to cause a polarization of the methane present. H. B. M.

Refining and Refinery Plant.

1481a. Patents on Refining and Refinery Plant. N.V. de Bataafsche Petroleum Maatschappij. E.P. 525,388, 27.8.40. Appl. 20.2.39. Process for separating fractions of relatively high paraffinic character from those of relatively low paraffinic character in hydrocarbon mixtures by crystallization and by the use of diluents. Crystallization is effected alternately from a solvent with good solvent power for paraffinic hydrocarbons and a solvent with good solvent power for non-paraffinic hydrocarbons.

K. W. Pepper. E.P. 526,117, 11.9.40. Appl. 7.3.39. Process of purification of unsaturated ketones adapted for use in the production of ketonic resins by subjecting the greenish-coloured ketone in the presence of water to the action of alkalis or basic materials or certain reducing agents.

Anglo-Iranian Oil Co. E.P. 526,165, 12.9.40. Appl. 3.2.39. Process for the alkylation of *iso*pentane or *iso*butane in which the *iso*paraffin is condensed with ethylene or with a mixture of olefines containing substantial proportions of ethylene at a relatively low temperature. The reaction mixture is vigorously stirred in the presence of sulphuric acid of high concentration, and cupric sulphate and mercurous sulphate are added to the mixture as reaction-promoting agents.

Dow Chemical Co. E.P. 526,387, 17.9.40. Appl. 14.3.39. Separation of butadiene from mixtures thereof with other hydrocarbons having four carbon atoms by fractionally distilling the liquefied hydrocarbons in the presence of liquid ammonia.

Edeleanu Gesselschaft m.b.H. E.P. 526,477, 19.9.40. Appl. 17.3.39. Improved process for the extraction and dewaxing of mineral oils. The improvement lies in interposing between the extraction plant and the dewaxing plant a compensating evaporator in which such a proportion of the sulphur dioxide contained in the raffinate solution is evaporated that a relatively small and constant addition of the solvent prevents liquid phase formation and the degree of dilution of the hydrocarbon mixture most suitable for the dewaxing process is not exceeded.

E.I. Du Pont de Nemours & Co. E. P. 526,496, 19.9.40. Appl. 17.3.39. Purification of an aliphatic dinitrile by bringing it into contact with a solution containing sulphurous acid or a water-soluble sulphite.

C. T. Anné. U.S.P. 2,213,798, 3.9.40. Appl. 18.6.38. Continuous method of removal of asphalt from oil in the presence of a solvent adapted to precipitate asphaltic constituents. H. B. M.

Chemistry and Physics.

1482. Polycyclic Aromatic Hydrocarbons. XXIV. J. W. Cook and R. H. Martin. *J. chem. Soc.*, 1940, 1125–1127.—Certain homologues of 1 : 2-benzanthracene give photo-oxides when oxygen is passed through their dilute solutions in carbon disulphide, exposed to light. This behaviour appears unrelated to the carcinogenic activity of the hydrocarbons. T. C. G. T.

1483. Dehydrogenation. II. The Elimination and Migration of Methyl Groups from Quaternary Carbon Atoms during Catalytic Dehydrogenation. R. P. Linstead and S. L. S. Thomas. *J. chem. Soc.*, 1940, 1127–1134.—Hydronaphthalenes containing methyl groups attached to quaternary carbon atoms have been dehydrogenated in the vapour phase over metallic catalysts. Over platinized charcoal the main reaction was dehydrogenation, accompanied by a straightforward elimination of methyl from the quaternary atom. When certain hydronaphthalenes were passed over platinized or palladized asbestos the reaction was accompanied by a migration of methyl to an adjacent carbon atom.

The catalytic dehydrogenation of various alkyltetralins in the liquid phase has also been examined. Those without a quaternary carbon atom were rapidly and quantitatively dehydrogenated. Those with such an atom were practically unaffected. T. C. G. T.

1484. Polycyclic Aromatic Hydrocarbons. XXV. 1- and 2-Alkyl Derivatives of 3 : 4-Benzphenanthrene. J. L. Everett and C. L. Hewett. *J. chem. Soc.*, 1940, 1159–1162.—Continuing the research into the carcinogenic properties of aromatic hydrocarbons, the authors have prepared derivatives of 3 : 4-benzphenanthrene. T. C. G. T.

1485. Mechanization of Polymerization. IV. Experiments Relating to the Constitution of the Solid Dimeride and the Liquid Trimeride of $\beta\gamma$-Dimethylbutadiene, and to the Separation of the Higher Polymerides. E. H. Farmer and J. F. Martin. *J. chem. Soc.*, 1940, 1169–1176.—The solid dimeride $C_{12}H_{20}$ obtained from $\beta\gamma$-dimethylbutadiene is possibly one of two methylenotetramethylbi*cyclo*heptanes. The trimeric portion of the polymeride is probably a mixture of isomeric hydrocarbons, although a part of it may be pentamethyl*iso*propenyloctahydronaphthalene. T. C. G. T.

1486. Mechanism of Polymerization. V. Dimerization of Unconjugated Pentadiene. A. Ahmad and E. H. Farmer. *J. chem. Soc.*, 1940, 1176–1178.—The pentadiene, when heated above 200° C., polymerizes like certain drying-oils. The product is a mixture of low-molecular polymerides, in which dimeride and timeride predominate. The dimeride consists mainly of 1-methyl-2-allyl*cyclo*hexene. A mechanism is suggested. T. C. G. T.

1487. Hydrogenation of Ethylene at Surfaces of Certain Oxides. I. Zinc Oxide and Zinc Chromite. J. R. Woodman and H. S. Taylor. *J. Amer. chem. Soc.*, 1940, **62**, 1393–1396.—Zinc oxide and chromite catalyse the hydrogenation of ethylene at and above room temperature. At 56° C. the reaction velocity on the oxide is independent of hydrogen, ethylene, and ethane partial pressures. On zinc oxide at 56° the number of active centres decreases owing to the deposition of polymers or to the decomposition of ethylene at the surface. This poison can be oxidized by air at 150° and above, and the product removed by evacuation at 450° C.

This is evidence that oxygen is strongly adsorbed on the active centres of zinc oxide above 150° C. Reduction of the zinc oxide takes place above 218°.

Ethylene polymerizes on zinc oxide at 218° without appreciable formation of permanent gases. At 445° polymerization is rapid, but accompanied by the formation of hydrogen and methane.

Small quantities of water vapour poison the surface of the zinc oxide completely at 56° and even at 400° C. T. C. G. T.

1488. Hydrogenation of Ethylene at the Surfaces of Certain Oxides. II. Molybdenum Oxide Compounds. J. F. Woodman, H. S. Taylor, and J. Turkevich. *J. Amer. chem. Soc.*, 1940, **62**, 1397–1399.—A catalyst prepared by the decomposition and reduction of ammonium nickel molybdate at 300° C. is active at — 80° in the hydrogenation of ethylene. Magnetic susceptibility measurements, together with poisoning experiments using hydrogen sulphide, have suggested that this activity is due to metallic nickel, very highly dispersed.

Catalysts prepared from ammonium phosphomolybdate and ammonium paramolybdate have shown negligible activity for ethylene hydrogenation below 256° C. T. C. G. T.

1489. Intermediate Complexes in the Friedel and Crafts Reaction. J. R. Norris and J. E. Wood. *J. Amer. chem. Soc.*, 1940, **62**, 1428–1432.—The preparation and some properties of the complexes having the following formulæ are described: $Al_2Br_6 \cdot s\text{-}C_6H_3(CH_3) \cdot HBr$, $Al_2Br_6 \cdot s\text{-}C_6H_3(C_2H_5)_3 \cdot C_2H_4Br$, $Al_2Br_6 \cdot s\text{-}C_6H_3(CH_3)_3 \cdot C_2H_5Br$. The complex $Al_2Br_6 \cdot s\text{-}C_6H_3(C_2H_5)_3 \cdot HBr$ did not react with CO_2 at 60 atmospheres, but a mixture of Al_2Br_6 and $s\text{-}C_6H_3(CH_3)_3$ under the same conditions gave high yields of the dimesityl ketone and *s*-trinethylbenzoic acid.

When a complex which contains aluminium chloride and benzene, toluene, triethylbenzene, or nitrobenzene was treated with hydrogen bromide at room temperature an exchange of halogen atoms took place. When the complex which contained aluminium bromide was treated with hydrogen chloride exchange also took place.

When acetyl chloride was condensed with benzene by means of aluminium bromide 77 mole-% of the hydrogen halides formed were hydrogen bromide. When acetyl bromide and aluminium chloride were used the mole-% of hydrogen chloride was 70. T. C. G. T.

1490. The Redistribution Reaction. VIII. The Relative Affinity of Mercury and Lead for Methyl and Ethyl Radicals. G. Calingaert, H. Soroos, and G. W. Thomson. *J. Amer. chem. Soc.*, 1940, **62**, 1542–1545.—Mixture of diethyl mercury with tetramethyl lead, and of dimethyl mercury with tetraethyl lead containing equal proportions of methyl and ethyl radicals and equivalent amounts of mercury and lead, undergo redistribution and yield the same random equilibrium mixture, in which the mercury shows a greater relative affinity than lead for methyl with respect to ethyl radicals. T. C. G. T.

1491. The Redistribution Reaction. IX. Redistribution of Halides and of Esters. G. Calingaert, H. Soroos, V. Hnizda, and H. Shapiro. *J. Amer. chem. Soc.*, 1942, **62**, 1545–1547.—Experimental data are presented for the redistribution reaction in the following six halide or ester systems: ethylene dibromide and ethylene dichloride, ethyl chloride and ethylene dibromide, ethyl bromide and ethylene dichloride, dimethyl oxalate and dibutyl oxalate, ethyl acetate and methyl butyrate, furfuryl acetate and ethyl furoate. T. C. G. T.

1492. Hexa-*p*-alkylphenylethanes. X. *p-cyclo*Hexyl Derivatives of Hexaphenylethane. C. S. Marvel and C. M. Himel. *J. Amer. chem. Soc.*, 1940, **62**, 1550–1553.—The dissociation of di-*p-cyclo*hexylphenyltetraphenylethane, tetra-*p-cyclo*hexylphenyldiphenylethane, and hexa-*p-cyclo*hexylphenylethane into five radicals has been measured by the magnetic susceptibility method. The dissociation in benzene at 26–28° is 9 ± 1% in 0·1*M* solution, 10 ± 1% in 0·05*M* solution, and 50 ± 7% in 0·01*M* solution, respectively. T. C. G. T.

1493. Hydrogen Fluoride as a Condensing Agent. XI. The Reaction of Alcohols and Ethers with Benzene. J. H. Simons and S. Archer. *J. Amer. chem. Soc.*, 1940, **62**, 1623–1624.—Additional studies of the hydrogen fluoride catalysed alkylations have been carried out using primary, secondary, and tertiary alcohols and their ethers. Good yields were obtained with *sec.* and *tert.* compounds at room temperature, but with primary compounds except benzyl alcohol and ether 100° C. was necessary.

The alcohols were found to react more readily than the corresponding chlorides, but when aluminium chloride is used the chlorides react more readily than the alcohols.

It is considered that the ease of reaction of benzyl alcohol is a strong argument against the hypothesis that an olefine is an intermediate in the reaction.

T. C. G. T.

1494. Hydrogen Fluoride as a Condensing Agent. XII. Reactions of Methyl, Ethyl, and Phenyl Compounds with Benzene and its Derivatives. J. H. Simons and H. J. Passino. *J. Amer. chem. Soc.*, 1940, **62**, 1624.—Hydrogen fluoride has been found to be a suitable catalyst for ethylation, but not for methylation or phenylation.

T. C. G. T.

1495. Polymethyl Aromatic Hydrocarbons. I. Synthesis of 1 : 2 : 4-Trimethylnaphthalene and 1 : 2-, 1 : 3-, and 1 : 4-Dimethylnaphthalene. M. C. Kloetzel. *J. Amer. chem. Soc.*, 1940, **62**, 1708–1713.—1 : 3- and 1 : 4-dimethylnaphthalene and 1 : 2 : 4-trimethylnaphthalene have been synthesized from β-benzoylpropionic acid. A similar synthesis starting from 1-tetralone is described for 1 : 2-dimethylnaphthalene.

T. C. G. T.

1496. Spectrographic Study of the Formation of 1 : 3-*cyclo*Hexadiene from *cyclo*Hexene. H. Stücklen, H. Thayer, and P. Willis. *J. Amer. chem. Soc.*, 1940, **62**, 1717–1719.—Ultra-violet absorption spectra measurements indicate the presence of traces of 1 : 3-*cyclo*hexadiene and benzene in all samples of *cyclo*hexene prepared by the dehydration of *cyclo*hexanol. Benzene can be removed by fractionation, but long-continued distillation increases the diene content. The latter may be removed by maleic anhydride. The diene is also formed by the action of ultra-violet light and by sunlight.

T. C. G. T.

1497. Spreading of Volatile Organic Liquids on Water in the Presence of Unimolecular Films. E. R. Washburn and C. P. Keim. *J. Amer. chem. Soc.*, 1940, **62**, 1747–1749.—A method has been developed for the measurement of spreading pressures by means of a film pressure balance and a small quantity of the spreading liquid put on a unimolecular film. By the method the following Harkins' spreading coefficients dynes/cm. were obtained: benzene 8·94, toluene 6·84, and nitrobenzene 3·76. The unimolecular films were palmitic or stearic acid.

T. C. G. T.

1498. Acetylenic *cyclo*Hexane Derivatives. C. S. Marvel, R. Mozingo, and R. White. *J. Amer. chem. Soc.*, 1940, **62**, 1880.—Four new derivatives have been prepared: 1-(3-methyl-1-pentyn-3-ol)-2-methyl*cyclo*hexanol, 1-(3-methyl-3-penten-1-ynyl)-2-methyl*cyclo*hexene, 2-methyl-1 : 1′-di*cyclo*hexanolacetylene, and 2-methyl-1 : 1′-di-*cyclo*hexenylacetylene.

T. C. G. T.

1499. Heat Capacity and Entropy, Heats of Fusion and Vaporization and the Vapour Pressure of *n*-Butane. J. G. Aston and G. H. Messerly. *J. Amer. chem. Soc.*, 1940, **62**, 1917–1923.—The heat capacity of *n*-butane has been determined from 12° K. to its boiling point. The transition point of *n*-butane is 107·56 ± 0·1° K., the melting point is 134·87 ± 0·05° K., and the boiling point is 262·66 ± 0·03° K. The heats of transition, fusion, and vaporization at the boiling point are, respectively, 494 ± 1, 1113·7 ± 2, and 5351 ± 15 cal./mole. The vapour pressure of *n*-butane from 210° K. to the boiling point is given by $\log_{10} P$ mm. $= 2352{\cdot}900/T - 16{\cdot}49230 \log_{10} T + 0{\cdot}01111869\,T + 48{\cdot}64763$.

The molal entropy of the ideal gas at the boiling point calculated from the experimental data is 72·05 ± 0·2 e.u. The molal entropies of the ideal gas and the superheated liquid at 298·16° K. are, respectively, 74·0 ± 0·2 and 55·2 ± 0·3 e.u.

The rotation of the ethyl groups of *n*-butane is hindered by a potential of the order of 30,000 cal./mole. Reliable thermodynamic functions for *n*-butane at high temperatures may be obtained despite uncertainty in the vibrational frequency assignment.
T. C. G. T.

1500. Heat Capacity and Entropy, Heats of Fusion and Vaporization and the Vapour Pressure of *iso*Butane. J. G. Aston, R. M. Kennedy, and S. C. Schumann. *J. Amer. chem. Soc.*, 1940, **62**, 2059–2063.—The heat capacity of *iso*butane has been determined from 12° K. to the normal boiling point. The melting point is 113·74° K. and the boiling point 261·44° K. The heats of fusion and vaporization at the boiling point are 1085·4 and 5089·6 cal./mole, respectively. The vapour pressure of *iso*butane from 200° K. to the boiling point is given by $\log P$ mm. $= -1716{\cdot}687/T - 6{\cdot}38879 \log T + 0{\cdot}0024132T + 24{\cdot}260325$.

The molal entropy of the liquid at the boiling point is 47·94 ± 0·10 e.u. The molal entropy of the ideal gas at the boiling point calculated from the experimental data is 67·52 ± 0·10 e.u. The molal entropy of the liquid at 298·16° K. extrapolated from the experimental data is 52·09 ± 0·10 e.u., whilst that of the ideal gas is 70·43 ± 0·15 e.u.
T. C. G. T.

Analysis and Testing.

1501. Measurements of the Viscosities of Oils under Reservoir Conditions. C. R. Hocott and S. E. Buckley. *Petrol. Tech.*, Aug. 1940, A.I.M.M.E. Tech. Pub. No. 1220, 1–6.—A simple rolling-ball viscometer, the construction of which is described, has been used successfully for routine determinations of the viscosity of subsurface samples of oil under reservoir temperatures and pressures. This instrument is adaptable to the measurement of a wide range of viscosities by varying the roll angle, the diameter of the roll tube, or the size of the ball.

A large number of subsurface oil samples have been examined, and it has been found that the viscosity of an oil is a minimum at the saturation pressure, and that the release of dissolved gas attending reduction of the reservoir pressure results in increased viscosity of the residual oil. Because of the nature of the variations of the viscosity with pressure, direct measurements on subsurface samples appear to be the only feasible method for determining the viscosity of any particular oil under reservoir conditions.
G. D. H.

1502. Development of Modified Quantitative Oliensis Spot Test. A. H. Benedict. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 13–43.—Owing to the tendency of certain high-sulphur-content Californian bitumens, having good service records, to give positive results in the Oliensis spot test an investigation was made of various methods of detecting overheating of bitumen. Blends of Californian bitumen and severely cracked material were examined for relationship between solubility in petroleum ether and proportion of cracked material; degree of unsaturation as measured by: (*a*) aniline point, bromine and iodine numbers, and absorption in sulphuric acid of vacuum distillate from the blends, (*b*) photochemical tests using daylight and ultra-violet light, (*c*) change in characteristics due to air blowing; relationship between physical properties of asphaltenes and proportion of cracked material as indicated by acetone solubility and molecular weight; quantitative Oliensis spot test.

The only method which appeared capable of being adopted for the detection of overheating of bitumen was the Oliensis test, and further investigation was devoted to the development and determination of the advantages and limitations of the modified quantitative Oliensis test. Various solvents were examined with a view to finding a solvent which would give more accurate results and greater sensitivity to small amounts of cracked material than naphtha; normal heptane was found to meet these requirements and it was decided to adopt this solvent and a xylene equivalent of 35% as a tentative dividing line between suitable and unsatisfactory bitumens.
A. O.

1503. Identification of Bitumen in Paving Mixtures. A. W. Attwool and D. C. Broome. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 60–76.—An account is given of investigations

of colorimetric methods of identifying bitumens and of the development of an instrument for this purpose termed a Panchrometer. A description of the instrument and method of operation is given and results obtained with various bitumens are tabulated. It is stated that in addition to differentiating between various types and grades of bitumen it is possible to identify mixtures and to determine the proportions and nature of the material used as flux with Trinidad asphalt. The Panchrometer may also be used to detect changes in bitumen resulting from overheating or weathering and to detect sedimentation in asphalt cements whether containing filler or otherwise. A further application of the instrument is in the study of the reaction between different types of bitumen and mineral aggregate. A. O.

Lubricants and Lubrication.

1504.* Machine Tool Oiling. Anon. *Auto. Engr*, 1940, **30** (397), 149.—With increasing accuracy demanded of machine tools, the complexity of units has increased, as also has the number of points requiring lubrication. Whereas the lubrication used to be left to the operator, sometimes resulting in over-lubrication and waste, this has now been largely replaced by automatic or mechanical methods.

With the use of circulating systems oils of lower viscosity can be used, resulting in lower fluid friction losses and lower consumption. An example of such a case is given, together with a description of centralized mechanical lubrication designed for use with both oil and grease. Alternatives to the latter are centralized hand-operated and air-operated systems, the latter employing electric timing devices for automatically starting and stopping the compressor. Oils of all viscosities can be handled, and there is automatic compensation for changes in temperature. H. L. W.

1505.* Cutting Fluids. Anon. *Auto. Engr*, 1940, **30**, (398), 175.—In view of the small cost of cutting fluids in relation to total production costs, it is surprising that so little attention is paid to their use; the advances made in machine tools, cutting speeds, etc., could not have been made without corresponding advances in cutting fluids.

It is suggested that the power exerted at the tip of the tool varies directly with cutting speed, a factor which has created problems for the cutting fluid manufacturers. With the increase in demand for and improvements in the methods of measuring surface finish the cry for high-quality work has been met without any rise in unit costs, to which cutting fluids have contributed in no small measure. As the fluid is primarily used to prolong tool life, a balance has to be struck between its properties as a coolant and as a lubricant. This naturally varies according to the machine and the work being done, and a proper selection of fluid will have an influence on tool life and, therefore, on production costs.

Although opinions differ as to the use of fluids with carbide-tipped tools, it is felt that, if the rate and direction of flow were properly controlled, much of the opposition to the use of fluids would disappear, and it appears that costs would be reduced. Tests in which surface roughness was measured have shown that the use of cutting fluids materially reduced surface roughness, and, therefore, the approach to true planar smoothness.

Advance in the manufacture of cutting oils has, moreover, made it possible to reduce considerably the number of different fluids required to cover the use of a wide range of metals and operations. The practice of different factories varies considerably, soluble oils and neat cutting oils being used for identical operations. In spite of such wide divergencies, general recommendations as to the type of fluid to be used can be given. In some cases where dry machining has been used, considerable saving has been effected by wet cutting; but this has required the alteration of tool rake, etc., to give maximum benefit. The quantity of fluid is important, a weak flow of little volume frequently giving worse results than dry machining. Alkaline media should not be used with aluminium, but a soluble oil has been developed which can be used for grinding non-ferrous metals, including aluminium.

The published research work on cutting operations is mainly American, and has shown that the saving in power can be considerable. American practice has been

outlined in a paper to the S.A.E., which gives the results of a co-operative investigation carried out by an independent group of investigators. A table is reprinted from the paper showing the requirements for various operations.

The use of soluble oils is discussed, the merits and demerits of the various types being analysed. Examples of the saving in tool life, particularly with the clear type of emulsion, are given. Although straight mineral oils are still used for some light operations, the neat cutting oils used nowadays are mainly sulphurized oils. The viscosity of these oils is of considerable importance, and savings have been proved by using an oil of lower viscosity; the use of summer and winter grades has even been introduced.

Although cutting oils are frequently blamed as the cause of skin diseases, it has been shown that personal cleanliness is the greatest safeguard. Certain types of oil do, however, favour bacterial growth, and therefore act as carriers. It is doubtful if the oil is itself to blame, and investigations frequently show that the infection has been introduced through lack of cleanliness, for which a cleaning unit has been found an advantage. The opinion is expressed that by drawing on the vast fund of experience of the oil companies users would be doing a great service to industry. H. L. W.

1506. Patents on Lubricants and Lubrication. L. C. Brunstrum. U.S.P. 2,211,921, 20.8.40. Appl. 17.5.37. Preparation of a gear lubricant by making a substantially neutral cup grease and thereafter grading a blend of asphalt containing unneutralized asphaltogenic acids, aluminium soap, and oil. Neutralization of the asphaltogenic acids is thus avoided.

C. E. Andrews and M. R. Fenske. U.S.P. 2,211,944, 20.8.40. Appl. 3.6.38. Conversion of high-viscosity lubricating oils to oils of lower viscosity, but having substantially the same viscosity index. A mixture of the high-viscosity oil and methanol is heated at a temperature between 300° and 400° C. under a pressure of 250–2000 lb./sq. in. in the presence of a reducing catalyst.

W. B. Hendrey. U.S.P. 2,212,020, 20.8.40. Appl. 1.4.37. Preparation of a lubricant consisting of a mineral lubricating oil containing 0·1–1·0% by weight of lecithin and 0·5–5·0% by weight of lanolin in order to improve oiliness and anti-corrosive properties.

W. B. Hendrey, U.S.P. 2,212,021, 20.8.40. Appl. 1.4.37. Preparation of a lubricating-oil composition consisting of a mineral lubricating oil, 0·1–1·0% of a phosphatide and 1–5% of a fatty oil.

M. T. Flaxman. U.S.P. 2,212,899, 27.8.40. Appl. 20.9.37. Preparation of a sulphurized lubricating oil consisting of a mineral lubricating oil and from ½ to 20% jojoba oil containing combined sulphur.

C. F. Prutton and A. K. Smith. U.S.P. 2,213,532, 3.9.40. Appl. 31.12.32. Preparation of a lubricant consisting of a major proportion of a hydrocarbon oil and a minor proportion of a halogenated aromatic hydroxy-compound.

B. H. Lincoln and G. D. Byrkit. U.S.P. 2,213,804, 3.9.40. Appl. 23.2.38. Preparation of a lubricating oil consisting of a hydrocarbon oil and a small quantity of an organic compound containing at least two sulphur atoms in a heterocyclic ring.

E. W. Cook. U.S.P. 2,213,856, 3.9.40. Appl. 6.7.38. Lubricating bearing surfaces having the corrosion susceptibility of cadmium-silver, cadmium-nickel, and copper-lead alloys. A lubricant having incorporated a sufficiently oil-soluble alkyl arsenite is applied to the bearing surfaces in corrosion inhibiting proportions.

B. H. Lincoln, A. Henriksen, and J. W. Wolfe. U.S.P. 2,213,988, 10.9.40. Appl. 16.9.38. Preparation of a lubricating composition containing a major proportion of a mineral oil and a halogenated thio-ether.

F. R. Moser. U.S.P. 2,214,379, 10.9.40. Appl. 22.11.37. Preparation of an extreme-pressure lubricant containing a major proportion of a mineral lubricating

oil and a minor quantity of mixed organic sulphonyl halides prepared from an aromatic normally liquid mineral-oil fraction soluble in liquid SO_2 and boiling substantially above the gasoline range.

R. Cannon and K. A. Varteressian. U.S.P. 2,214,401, 10.9.40. Appl. 2.3.37. Preparation of a lubricating oil in which is incorporated a quantity of oxalic acid sufficient substantially to stabilize the oil.

K. A. Varteressian. U.S.P. 2,214,443, 10.9.40. Appl. 20.2.37. Preparation of a lubricating oil having a lake-forming substance in solution therein in quantity sufficient to stabilize against bearing corrosion.

K. A. Varteressian. U.S.P. 2,214,444, 10.9.40. Appl. 2.3.37. Stabilization of a lubricating oil by adding thereto sufficient of a stabilizing substance resulting from attaching three phenolate groups to a single arsenic atom to inhibit corrosion.

H. B. M.

Gas, Diesel and Fuel Oils.

1507. Patents on Gas, Diesel and Fuel Oil. Standard Oil Development Corp. E.P. 525,962, 9.9.40. Appl. 1.3.39. Continuous process for the production of gasoline of high octane number. A liquid mixture of *iso*butene and an olefine is fed into a pool of concentrated sulphuric acid and the temperature of the pool maintained within the range 60–175° F. under a pressure substantially equal to the vapour pressure of *iso*butane at the reaction temperature. Any increase in temperature of the reaction mass causes vaporization of the *iso*butane. Subsequently the vaporized *iso*butane is withdrawn from the pool, liquefied, and returned to the fresh feed. Normally liquid substantially saturated hydrocarbons suitable for motor fuel are continuously withdrawn from the pool.

Texaco Development Corp. E.P. 526,149, 11.9.40. Appl. 9.3.39. Process for the manufacture of high anti-knock gasoline hydrocarbons by subjecting *iso*butane and normally gaseous olefines heavier than ethylene to the action of strong sulphuric acid, whilst maintaining an excess of *iso*butane.

T. W. Pfirrmann. U.S.P. 2,213,407, 3.9.40. Appl. 10.7.37. Process for improving the ignition properties of diesel power fuels by treating in the liquid phase with a gas comprising oxygen in such proportions and for such a reaction period that no substantial proportions of oxygen-containing hydrocarbon compounds are formed and the boiling curve of the distillable portion of the original material is substantially unaltered.

E. Lieber. U.S.P. 2,214,059, 10.9.40. Appl. 14.7.38. Fuel for diesel engines consisting essentially of a hydrocarbon fuel with which is blended a minor proportion of a tertiary alkyl nitrosyl mercaptan. H. B. M.

Asphalt and Bitumen.

1508. Report of Committee on Anti-Skid Properties of Road Surfaces. G. E. Martin. *Highway Res. Board, Proc. Nineteenth Annual Meeting*, 1939, 126–128.—A preliminary account is given of an investigation of the anti-skid properties of thirty-six road surfaces which included Portland cement concrete, asphaltic concrete, bituminous macadam, and oil mat, ranging from surfaces not opened to traffic to surfaces in use for eighteen years.

The apparatus consisted of a specially constructed trailer towed behind a light truck, with a dynamometer placed in the towing bar to record the tractive resistance of the trailer. The tests were made by locking one wheel of the trailer while towing at a constant speed, speeds of 10 to 40 miles per hour being used under wet and dry conditions. Retreaded tyres were used to obtain a smooth surface, and a sprinkling tank was driven ahead of the test vehicle for tests on wet surfaces.

The main series of tests was made with a wheel-load of 800 lb., but a few tests were made with a load of 400 lb. It is stated that the tests confirm that any of the pave-

ments are satisfactory at reasonable speeds and under dry conditions, but at high speeds and with wet surfaces variations in skid resistance were observed. Sand-textured surfaces having coefficients of friction of 0·40–0·60 when dry drop to values of 0·20–0·30 when wet, whereas coarser-textured surfaces are only slightly affected by water. Surfaces which permit the draining of water are more skid-resistant when wet than when dry.

The coefficient of friction decreased from 25 to 40% on dry surfaces and from 15 to 25% on wet surfaces when the wheel-load was doubled.

Tests of the length of skid of a car with wheels locked, on eleven types of surfacing are also reported. The hydraulic brakes on the car were operated by air and the length of skid was determined by pistol-shot marks on the pavement. Tyres which had been worn smooth were employed and surfaces were wetted prior to tests. Results are tabulated. A. O.

1509. Use of Tar in Base Stabilization. T. F. Loughborough, A. C. Miller, N. F. Schafer, and A. C. Tilley. Arranged P. Rapp. *Highway Res. Board, Proc. Nineteenth Annual Meeting*, 1939, 504–516.—Details are given of costs and methods of construction of tar-stabilized road bases. A. O.

1510. Fundamentals in Asphalt Heating Equipment. H. G. Levitt. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 1–12.—The author discusses the factors involved in the design and operation of asphalt heating equipment.

The results of examination of two commercial heaters are considered. It is thought that direct heating has certain advantages, and risk of local overheating may be eliminated by specifying operation and design limitations. A. O.

1511. Characteristics of Various Asphalts as Regards Emulsification. R. M. Heine. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 77–85.—It is pointed out that differences in crudes and methods of refining affect the ease of emulsification of asphaltic bitumen as well as the mechanical, thermal, and chemical properties. This is attributed to variation in the amounts of easily saponified material in the bitumens, and generally bitumens containing small amounts are more difficult to emulsify; the estimation of these substances is very difficult.

Discussing the results of tests on emulsions prepared from various types of bitumen, it is stated that the residues from distillation may differ in penetration, although the same bitumen has been used in two emulsions, while different bitumens of the same grade may also give residues of different penetration. The ductility of the residue may be affected by variation in penetration, amount and nature of stabilizing agent, or by blending bitumens. The demulsibility also depends on the amount and nature of the stabilizing agent used. The author inquires whether viscosity is a function of absorption, adsorption, and free liquid, or of bitumen content and particle size. Settlement is said to vary with penetration and specific gravity, and may be affected by the nature of the bitumen. The cement test is stated to be a function of the bitumen when differences in ease of emulsification are shown, whilst dehydration depends on the penetration and specific gravity of the bitumen and on the nature and proportion of stabilizing agent used. A. O.

1512. Surface Treatment Studies. T. E. Shelburne. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 44–59.—A brief account is given of surface-treatment investigations in Indiana and of investigation of the crushing of bituminous-coated aggregates under road rollers.

The term surface treatment is applied to the process of road mixing aggregates and fluid bituminous materials to obtain a wearing course less than 1 in. in thickness.

Surface-treatment failures were extensive in the spring of 1936, and investigations were undertaken to determine the cause and, if possible, to extend the life of the surfaces. Few surfaces had lasted more than 2 years, although it was considered that the average life should be at least 3 years. Samples were examined for thickness, condition of surface, bitumen content, and sieve analysis, and an attempt was made to correlate bitumen content and surface area of the aggregate with the behaviour of the treatment, but no definite relationship could be established.

A lack of uniformity of texture was observed, bitumen content ranged from 3 to

12%, and surface area of the aggregate varied from 1000 to over 6000 sq. cm./100 gms., whereas the original aggregate had a surface area of approximately 300 sq. cm./100 gm.

The most prevalent type of failure, excluding base failure, was ravelling, and it was found that treatments constructed in late autumn and under adverse weather conditions ravelled more than those constructed earlier in the season.

In order to determine the effect of type, quantity, and method of application of bituminous material and size and amount of aggregate, fifty-one test sections 1000 ft. in length were constructed with three types of bituminous material and with aggregates of different gradings from two sources.

Measurements of texture were made with a profilometer.

The degradation of surface treatment aggregates was investigated by examination at periodic intervals of samples from test roads constructed with various aggregates coated with liquid bitumen and emulsion. Degradation under the roller was also investigated by examination of coated and uncoated aggregates compacted on flexible and rigid bases by means of 5- and 10-ton rollers.

The results indicated that the rate of degradation is greater with soft than with hard aggregates and also greater with large- than with small-sized aggregate from the same source. Particle shape influenced degradation, crushed gravel being affected to a greater extent than uncrushed gravel from the same source. Degradation under the roller was much greater on a rigid than on a flexible base, and the Los Angeles abrasive machine operated at 100 revs. gave a good indication of the amount of degradation under the roller.

Degradation during mixing, rolling, under traffic, and in the Los Angeles machine tended ultimately to correspond to Fuller's grading for maximum density. It is suggested that rolling should be reduced and a more suitable grading selected in preference to the practice of producing ultimate grading by crushing under the roller.

A. O.

1513. Patent on Asphalt. N. T. Anderson. E.P. 526,351, 17.9.40. Appl. 14.3.39. Preparation of light road-surface material consisting of a bituminous binder and a mineral aggregate consisting wholly or partly of burnt flint. H. B. M.

Special Products.

1514. Patents on Special Products. Parke Davis & Co. E.P. 526,024, 9.9.40. Appl. 12.16.39. Preparation of 5 : 5-diphenyl hydantoins or thiohydantoins in which the phenyl groups may be substituted or unsubstituted by reacting a benzoin with urea or thiourea in an alkaline solution containing an oxidizing agent.

Röhm and Haas Gesellschaft. E.P. 526,122, 11.9.40. Appl. 9.3.38. Preparation of β-chloropropionic acid by oxidizing β-chloropropionaldehyde with nitric acid of about 70% strength.

N.V. de Bataafsche Petroleum Maatschappij. E.P. 526,215, 12.9.40. Appl. 10.3.39. Production of saturated hydrocarbons with branched chains from saturated straight-chain hydrocarbons boiling below 200° C. The initial hydrocarbons are contacted at temperatures below 150° C. with double compounds of aluminium halides with aromatic hydrocarbons.

E.I. Du Pont de Nemours & Co. E.P. 526,497, 19.9.40. Appl. 17.3.39. Manufacture of aliphatic amines by bringing a liquid-heated mixture comprising essentially ammonia, hydrogen, and an aliphatic nitrile continuously into contact with a stationary solid hydrogenation catalyst.

The Mathieson Alkali Works. E.P. 526,662, 23.9.40. Appl. 24.3.39. Stabilization of alkali-metal alcoholate compositions by introducing therein a minor proportion of a catalytic anti-oxidant selected from the class consisting of amines, amine hydrochlorides, and amides.

B. W. Story. U.S.P. 2,211,798, 20.8.40. Appl. 2.3.37. Preparation of an oil composition by admixing with a highly refined petroleum oil a material selected from

the class of disulphides consisting of the alkyl disulphides and the thiuram and thiazo-disulphides. The latter is added in sufficient quantity to diminish substantially the production of acidic compounds in the oil as the result of atmospheric oxidation at elevated temperature.

E. W. Gardiner and G. H. Denison. U.S.P. 2,211,972, 20.8.40. Appl. 4.10.38. Preparation of a compounded mineral oil in which is incorporated an aluminium phenate containing a substituted phenolic radical having more than 10 carbon atoms.

B. A. Dombrow. U.S.P. 2,214,634, 10.9.40. Appl. 21.5.40. Production of a soluble cutting oil base composed of a water-insoluble soap of an acid selected from the group consisting of naphthenic acids and unsaturated higher fatty acids, an emulsifier, and a mineral oil. H. B. M.

Detonation and Engines.

1515. Effect of Traffic Delays on Gasoline Consumption. A. J. Bone. *Highway Res. Board, Proc. Nineteenth Annual Meeting*, 1939, 99–125.—A study has been made of gasoline consumption and travel time on a route in Boston, Mass., the streets of which are narrow, crooked, and congested. Test runs were arranged to obtain a representative sample of busy traffic conditions; other tests were made when there was no congestion. Under ordinary conditions a driver required about 7 minutes to travel a mile, spending 2¼ min. in traffic stops, 1¼ min. in first or second gear, and 3 min. in high gear. The average consumption was 12·1 miles per gallon in city traffic and 18·2 m.p.g. without traffic interference.

Further tests were made on by-pass roads (Parkways) and a more congested parallel route. These showed an average consumption of 20·1 m.p.g. and an average speed of 38 m.p.h. on the Parkways compared with 18·4 m.p.g. and 25 m.p.h. on the alternative route. K. A.

Coal and Shale.

1516. Patents on Coal. Yorkshire Tar Distillers, Ltd. E.P. 525,813, 5.9.40. Appl. 28.12.38. Purification of coal-tar hydrocarbons from sulphur compounds. These are passed at an elevated temperature and in the presence of hydrogen or of a gas containing free hydrogen over or through a catalyst consisting of or containing a metallic thiomolybdate.

Yorkshire Tar Distillers, Ltd. E.P. 525,814, 5.9.40. Appl. 28.12.38. Process for the purification of coal-tar hydrocarbons from sulphur compounds in which these are passed at an elevated temperature and in the presence of hydrogen or of a gas containing free hydrogen over or through a catalyst consisting of or containing a metallic thiotungstate.

H. Dreyfus. U.S.P. 2,213,272, 3.9.40. Appl. 29.1.38. Treatment of crude liquid coal products by transforming phenolic compounds contained therein into liquid hydrocarbons without utilization of hydrogen. The crude liquid coal products are heated with a finely divided metallic zinc. H. B. M.

Economics and Statistics.

1517. Reports from Mexico, Uruguay, and Chile. Anon. *Bol. Inform. Petroleras*, May 1940, XVII (189), 51–58.—*Mexico:* A table is published showing the annual production of oil in cubic metres since the commencement in 1901, and in a note it is pointed out that a gradual recovery in production and export since the drop due to expropriation imposed by the Government is recorded, indicating, according to their statement, that the alleged boycott by the big companies has failed.

Uruguay: Decree authorizing changes in the basic prices of heavy fuel oil, gas oil, etc.

Chile: Decrees suspending import duties on coal and fixing maximum prices for sale of fuel oil and diesel oil. H. I. L.

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Swinehart, C. F., 1598

Tabor, D., 1590
Taliaferro, D. B., 1569
Thomas, M. B., 1570
Travers, M. W., 1585, 1586
Turechek, G. F., 1570

Wayne, T. B., 1552
Weatherby, B. B., 1531
Weber, 1522
Welborn, J. G., 1599
White, A. G., 1619
Williams, N., 1523
Wingfoot Corporation, 1611
Winterborn, H. F., 1602
Winthrop Chemical Co., 1611
Wolfers, E. C., 1570

Vesely, V. M., 1552
Vesterdal, H. G., 1578

Young, J., 1570

Zeidler, G. A., 1570

Geology and Development.

1518.* Oil-field Waters of Wyoming and their Relation to Geological Formations. J. G. Crawford. *Bull Amer. Ass. Petrol. Geol.*, **24**, 1940, 1214–1329.—This paper gives tabular and graphic analyses of waters from the oil- and gas-fields of Wyoming, excepting those areas where lenticularity of beds, severe faulting, and other factors have prevented free migration of water.

In the Rocky Mountain region oil-field waters are exceptionally low in concentration as compared with other regions. The salinity of most Wyoming waters is so low that little, if any, connection can be made with connate waters. Analyses suggest that all the oil-field waters of Wyoming have been considerably modified by the infiltration of surface water.

Post-Chugwater waters are essentially solutions of sodium salts; pre-Chugwater sediments, however, yield water in which calcium and magnesium sulphates predominate.

Frontier waters are solutions of sodium chloride and sodium bicarbonate in varying proportions, sulphate and alkaline earths occurring only as surface or drilling water contamination.

"Dakota Group" waters are solutions of sodium salts, although they contain appreciable amounts of sulphate. Oil from the sands of this group is obtained from the deeper-seated beds where a higher chloride water occurs.

Generally, Sundance waters are solutions of sodium salts and are similar, except for concentration, to Frontier and "Dakota Group" waters. The chief Sundance sandstone is much more uniformly distributed than the sands of the Frontier and "Dakota Group," and is the youngest formation water that contains hydrogen sulphide.

The Chugwater formation provides a dividing line between the primary waters of the formations above and the secondary waters of the beds below. Chugwater water is usually concentrated, and ranges from 30,000 to 50,000 parts per million.

The youngest subsurface waters are the Embar waters, in which secondary salinity is prominent. Hydrogen sulphide is usually present, particularly in the waters associated with black oil.

In most Tensleep waters secondary characteristics dominate the chemical system, with secondary salinity usually occupying 40–70%. Many Tensleep waters are characterized by very low bicarbonate content, a feature which ordinarily enables them to be differentiated from Embar water.

Madison water resembles Tensleep, except that it is usually marked by a somewhat higher secondary salinity.

Twenty-four figures accompany the paper. G. S. S.

1519.* Paleogene of Barbados and its Bearing on History and Structure of Antillean–Caribbean Region. A. Senn. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 1548–1610.—Six-sevenths of Barbados is covered by Pleistocene reef-limestones known as Coral Rock, which in the northern half of the island has been elevated to form a dome-like structure reaching a height of more than 335 metres. The roof of the dome has been partly removed by erosion. The remaining portion of the island consists of older formations underlying the Coral Rock. This region has been called the "Scotland District" on account of its mountainous character with highly dissected ridges and numerous ravines and valleys. It contains the best exposures of the older rocks, and these receive special attention from the author.

The oldest sediments in Barbados have been termed the *Scotland formation*, and this has been subdivided into a Lower (or St. Andrew's Beds) and an Upper series. The older beds, in which shales predominate, are regarded as Lower Eocene in age, and the younger, consisting mainly of sands, of Middle Eocene age.

Overlying these are the *Jones River Beds*, consisting mainly of pebbly silts with inclusions of hard greenish clay traversed by numerous cleavage planes containing free inspissated oil. The rocks are derived from various parts of the Scotland formation, although the greater part of the silts certainly originates from the Lower Scotland.

Lying with a strong angular unconformity on these older beds is the *Oceanic formation*, and a general and detailed type section is given of this formation occurring

at Mt. Hillaby. It consists essentially of Radiolarian earth and marlstone, has a total thickness of 620 ft., and is Upper Eocene and Lower Oligocene in age.

Bissex Hill Marl. This was originally included in the Oceanic formation, but is now regarded as quite separate and different from it, not only in lithological characters, but also in age. Consisting chiefly of a yellow to orange-coloured sandy Globigerina marl, it has a thickness of approximately 50 ft. and is of uppermost Oligocene or Lower Miocene age.

Correlation of all these beds with other parts of the Caribbean is discussed.

The paper concludes with a summary of the geological history of the Antillean–Caribbean Region, and it is considered that during Upper Cretaceous and Eocene times a land or shallow-water connection linked the Caribbean and European Mediterranean regions, a connection, however, which was broken during the Upper Eocene orogeny.

A large correlation chart of the Tertiary and Cretaceous formations of the Antillean–Caribbean region accompanies the paper. G. S. S.

1520.* Palaeozoic Limestone of Turner Valley, Alberta, Canada. W. D. C. Mackenzie. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 1620–1640.—The Palaeozoic Limestone, commonly referred to as the "Madison lime," and the probable equivalent of the Madison in Montana, is responsible for practically all the gas and oil production in the Turner Valley field. It is correlated with the Rundle formation of the Banff section and is of Mississippian age.

The main producing zones are the upper and lower porous zones of the limestone, both being dolomitic and crystalline. The extent of these is estimated in a profile which accompanies the paper.

The porosity and permeability of the rock show wide variations from well to well. Such variations, due to the presence or absence of secondary calcite in the porous zones and to fractures in certain areas, make the estimation of reserves on the volumetric method deceptive. G. S. S.

1521.* Lower Ordovician Sand Zones ("St. Peter") **in Middle Tennessee.** K. E. Born. *Bull. Amer. Ass. Petrol. Geol.*, 1940, **24**, 1641–1662.—This paper discusses the present status of the "St. Peter" in Tennessee, and gives data and suggestions concerning possible correlations with the standard Lower Ordovician section.

A number of the deeper wells in the Central Basin and Highland Rim areas of Tennessee have penetrated sandy zones in the Lower Ordovician. These zones, which average less than 10 ft. in thickness, are made up of subangular to well-rounded pitted and frosted quartz grains associated with magnesian limestone and dolomites and often cherty material.

From an examination of thirty well samples it is shown that (1) although sandy zones do occur in the pre-Stones River rocks, no true quartz sandstones have been proved; (2) these zones definitely occur in the upper part of the Knox dolomite group, thereby fixing a Canadian age for the "St. Peter" zone, and (3) that they do not occupy a definite stratigraphical position with reference to established subsurface markers. It is concluded, therefore, that the "St. Peter" of middle Tennessee is a sporadic development of sandy zones in the upper part of the Knox dolomitic group.

Thus, since the name "St. Peter" has become both misleading and confusing, the author recommends its rejection in the Upper Cumberland district. G. S. S.

1522.* Tuscaloosa Discovery Heightens Oil Interest in Mississippi. G. Weber. *Oil Gas J.*, 19.9.40, **39** (19), 62.—Commercial oil has been found at 6,110–6,115 ft. in the Tuscaloosa at Tinsley, Mississippi. The overlying Eutaw and Selma are productive at Tinsley and the Eutaw at Pickens. A number of wells have penetrated the Tuscaloosa in Mississippi but few have been proper tests.

The Tuscaloosa outcrops in South Tennessee, north-east Mississippi, and across Alabama to Georgia. It dips south-south-west, and is within easy reach of the drill in the centre of the state. It is absent in the extreme west-central part. The Tuscaloosa is predominantly sandy, but has gravel and pebble beds, and red and maroon mottled clay shales are common. There are lignite seams, but a marine section is known in the lower third. At the outcrop in West Alabama the thickness

is estimated at 1,000 ft. It thins northward to 270 ft. in north-east Mississippi. Some geologists correlate the Tuscaloosa with the Woodbine of Texas, whilst others correlate it with the overlying Eagleford.

Only four closed Tuscaloosa structures have been drilled—Tinsley, Jackson, the Hatchetigbee anticline and the Quitman fault structure. The Tuscaloosa is absent on top of the Jackson structure, and a test showed oil in an igneous rock. On the Hatchetigbee anticline oil showings were found in Tuscaloosa sands, but on the Quitman fault structure the Tuscaloosa showed no oil although there were impregnations in the overlying Eutaw. On the Midway salt dome of south Mississippi a well encountered 100 ft. of asphaltic sand in a sand correlated with the basal Tuscaloosa. G. D. H.

1523.* Lolita Field One of Texas' Most Active. N. Williams. *Oil Gas J.*, 3.10.40, **39** (21), 16.—Up to 7th September, seventeen producing wells had been completed at Lolita. This field is expected to be quite good, and oil has been proved over an area more than 1¾ ml. from east to west and over ¾ ml. from north to south without the edges having been defined. At present there are two producing areas, one round the discovery well and the other round the second well about 1¼ ml. to the west. The gap between these is gradually being filled. There are indications that they represent two local structures, or that they are separated by a major fault, for they have different water levels, and a definite gas cap has been shown so far only in the western area. The structure is apparently an east–west anticline, with two producing sands at 5900 ft. and 6400 ft. in the Frio.

The discovery well had a potential of 335 brl./day of 34-gravity oil on a ½-in. choke. Production is restricted and development is on a basis of one well to 10 acres.
G. D. H.

1524.* Well Logs and Field Data of Prospective Oil Areas: Western South Dakota. Anon. *Oil Gas J.*, 10.10.40, **39** (22), 88B.—A few wildcat wells have been drilled in the area covering western South Dakota and the adjacent States, but it is virtually unprospected. Cretaceous and younger beds are at the surface, except in the Black Hills region, where all the formations in the district outcrop together with the pre-Cambrian. Small structures are known along the Missouri river, and there is also the Baker–Glendive anticline, which has given gas for years, and on which oil-shows have been found in the Madison and Jefferson limestones.

The Lance Creek field of Wyoming is the most important oil-field in the area. It yields oil from the Dakota, Sundance, and other sands.

Drift renders the location of structure difficult, but there are doubtless favourable structures. The absence of good reflecting horizons reduces the effectiveness of geophysical methods. In all probability there are many unconformity and stratigraphic traps, although the oil possibilities of some of the beds are somewhat discounted by the unfavourable feature of fresh water therein. G. D. H.

1525.* Well Logs and Field Data of Active Oil Areas—South-west Michigan. Anon. *Oil Gas J.*, 24.10.40, **39** (24), 36B.—Muskegon, the first oil-field in South-west Michigan, was brought in in 1927, and has given 6,700,000 brl. of oil from the Dundee limestone. Since 1926 a number of fields have come in.

Much of the area is covered with glacial drift, rendering the determination of structure difficult. Moreover, this factor has caused geophysical work to be only partly successful. This area forms the south-west flank of the Michigan basin, and is underlain by the Mississippian. There is a series of sub-parallel anticlinal ridges on which the oil occurs. The main production is from the Traverse (Devonian) limestone, but oil is also obtained from the Monroe and Dundee.

The area is not fully prospected and may well yield additional oil-fields.
G. D. H.

1526.* California Experiencing Lean Discovery Cycle. Anon. *Oil Wkly*, 30.9.40, **99** (4), 16.—No major additions to California's crude-oil reserves have been made for more than a year. Field extensions and deeper discoveries seem to hold out most promise. The major-discovery periods in California have run in cycles for 35 years.

After each lean period a discovery cycle has added adequately to the diminishing reserves.

The chief exploratory interest still centres on the San Joaquin Valley, which is about 50% tested. Deeper discoveries have carried production down to more than 13,000 ft. Geophysical work revealed twenty structures in less than three years, and seven of the first nine drilled gave oil or gas, but recent wildcatting has not been so successful. Prior to the discovery of Wilmington the Loss Angeles basin was considered to be 90% prospected. Geophysical work has not been very satisfactory in some parts of the basin. The present known reserve is but a fraction of the 2,600,000,000 brl. of oil already produced.

The Santa Maria valley still remains an important oil reserve, but there, too, there has been a lack of discoveries. The Sacramento Valley is regarded as an important potential oil reserve, although development has been limited to tests which for the greater part stopped short of conclusive depths.

New Eocene production has been developed on a nose or extension east of the old Coalinga field. Oil-bearing formations will probably be found to a depth of more than 20,000 ft. at Ventura Avenue, the Miocene not having been tested there.

Under present proration several years may be required to obtain the full return on the discovery costs. Since 1920 about 3100 dry holes have been drilled, and one oil- or gas-field has been found for each fifty-three dry holes. The cost of finding a new field has been more than $5,000,000, but the average value of all fields found in that time has been several times the discovery cost.

A table gives the production to the beginning of 1940, the estimated reserves, and proved acreage for all the fields of California. G. D. H.

1527.* This Year Indicated as Third Most Active in Drilling. Anon. *Oil Wkly*, 7.10.40, **99** (5), 12.—In 1920 33,911 wells were drilled in response to a $3 price for crude, and 33,112 in 1937. If field work continues at the present level to the end of 1940, about 31,000 new wells will have been drilled in U.S.A. 23,445 wells had been drilled there up to the end of September. The natural decline of Illinois has considerably reduced the threat of over-production.

Tables and diagrams give data about the daily and monthly completions in recent years. Marked increases in well completions this year have been shown by Mississippi, Indiana, Pennsylvania, Kansas, South Louisiana, Texas Panhandle, West Central Texas, Montana, Wyoming, Illinois, Oklahoma, Ohio, and New Mexico. G. D. H.

1528.* Mississippi's Potentialities still Undetermined. Anon. *Oil Wkly*, 28.10.40, **99** (8), 10.—In the twelve months following the discovery of Tinsley, exploratory drilling results in Mississippi have been disappointing on the whole, for only one further small field (Pickens) has been discovered. However, many of the wells drilled have had a questionable geological background, and numbers of them have stopped short of decisive depths. Many of the Mississippi formations are irregular and lenticular, and geophysical interpretation of the area has not been easy. About 75% of the geophysical work has been of little value because of the rush for quick results.

All three of Mississippi's major geological provinces seem favourable for oil and gas, but production has been established only in the central province. The Palaeozoic, probably the Mississippian, may prove productive in the north-east province, for there are gas reserves at several points, and the Hartsell sand has several strong oil-shows. The central province gives oil from the Selma and Eutaw, and the Tuscaloosa at Tinsley. The Jackson gas-field and the Pickens oil-field also lie in this province. The coastal province has many prospects, but so far has given no oil.

Geophysical activity has declined considerably during the last few months. Most of it has been done with the gravimeter and the seismograph. Features of relatively low relief are now being sought. The Tinsley structure is believed to have been formed by an igneous intrusion, with some salt flowage over it. It is essentially an anticline with extensive cross-faulting. The oil reserve is put at 25,000,000 brl., exclusive of the Tuscaloosa. Details are given of the various producing sands.

Pickens gives oil from the Eutaw. The closure is only 120 ft. G. D. H.

1529.* Measurement of Compressibility of Consolidated Oil-bearing Sandstones. C. B. Carpenter and G. B. Spencer. U.S. Bur. Mines. Report of Investigations No. 3540, October 1940.—It has long been apparent that subsidence of ground surface overlying producing fields does take place as a result of subsurface mining operations, and the opinion has been expressed by many engineers and geologists that the weight of earth formations overlying oil-bearing reservoirs causes compression and compaction of the reservoir sands and rocks as oil and gas are withdrawn from them. A large number of oil-producing rocks are sandstones, consolidated by natural cementing materials, but hitherto few experimental data have been available concerning their compressibility.

This paper embodies the results of studies of subsidence in certain Texas Gulf Coast oil-fields and of experimental work undertaken to determine reduction in volume and compressibility of consolidated oil-bearing sandstone cores under pressures up to 8000 lb. per square inch.

During the course of these investigations attempts were made to reproduce as nearly as possible conditions and forces in operation in a petroleum reservoir as oil and gas are withdrawn. Results showed that in so far as the rocks tested were concerned, a differential hydrostatic pressure of 8000 lb. per square inch caused a maximum reduction of 1·084% in gross volume and a maximum reduction of 3·608% in pore space. Thus it was deduced that compressibility was not sufficiently large materially to influence estimates of reservoir content and ultimate recovery. Maximum pressure applied during these tests was equivalent to the normally contemplated differential pressure in wells at a depth of 14,134 ft. As most wells in this field do not exceed 8000 ft. in depth, it was concluded that maximum compressibility of the oil-bearing rocks could safely be ignored.

Finally, the hypothesis was advanced that subsidence of ground surface overlying oil-fields is in many cases due not to changes in volume occurring within the reservoir itself as oil and gas are withdrawn, but results from dehydration and consequent shrinkage of shale-beds adjacent to oil-bearing reservoir rocks. H. B. M.

1530.* 525 Million Barrels in Sight in Illinois. G. F. Moulton. *World Petrol.*, June 1940, **11** (6), 30.—Since March 1940 the daily production of Illinois has exceeded 425,000 brl., placing the State third to Texas and California in oil output.

The Illinois basin has great thicknesses of marine sediments which have been only slightly disturbed by folding. Beneath glacial drift are Pennsylvanian and older rocks. The Mississippian is variable in thickness, and the Chester series has seven productive horizons. In the lower Mississippian limestones predominate, and oil is obtained from the McClosky and St. Louis limestones. Limestone in the Upper part of the Devonian has proved productive. Other deeper horizons are expected to yield oil, including basal Devonian sandstones, Silurian dolomite, the Trenton limestone and the St. Peter sandstone.

The old eastern Illinois fields are on the La Salle anticline, and the fields of the Centralia district are on the DuQuoin anticline. There are other anticlinal trends with local highs giving oil accumulation. Related to the Rough Creek fault is an east–west fault zone, the oil prospects of which, however, do not seem as good as elsewhere in Illinois.

Most of the Illinois fields are associated with anticlines, but in the sandstones lenticularity does play a part, and porosity conditions in the limestones are similarly important.

Many formations remain to be tested. That part of the basin east of the DuQuoin anticline seems very favourable, although many of the structures are relatively small. Stratigraphical traps may be important immediately west of the eastern fields. On 1st June, 1940, estimates placed the reserves at 525,000,000 brl., with 75% of the total in fields on the western side of the Illinois basin. At present discoveries are keeping pace with production. Much depends on the results of testing the Trenton in the Centralia district and on the investigation of the Devonian limestone in the old eastern fields. G. D. H.

Geophysics.

1531.* History and Development of Seismic Prospecting. B. B. Weatherby. *Geophys.*, 1940, **5** (3), 215–230.—A brief survey is made of the early work from the time of Mallet

in the 1840's until 1914, when Mintrop applied for his patent covering refraction profiling. The Seismos Gesellschaft started work in Mexico in 1923 and in the Gulf in 1923–24. Fan-shooting was developed in the Gulf on account of the great difficulty of interpreting profiles. Electrical detectors and amplifiers were developed in 1926, as was also the use of radio communication between shot-point and detector. These improvements made the instruments many times more sensitive than the German mechanical types, and greatly increased speed and reduced costs. There resulted a period of intense activity in the Gulf, accompanied by the discovery of many domes. The method had little success in California, however, mainly because of the absence of high-speed uplifts, such as salt, which could be discovered by fan-shooting. Refraction profiling was partly successful in the West Texas Permian Basin.

The reflection method developed from the use of artificial seismic waves for depth-finding. Successful experimental work was carried out in 1921, and one of the first reflection projects was on the Nash Dome in 1926. In 1927–30 successful work was carried out on the Seminole plateau of Oklahoma, using the Viola Lime as marker. Dip-shooting was developed in the Gulf in 1929. Since then considerable improvements in instruments and technique have been made, and the number of reflection crews in the U.S.A. increased from four to about 250 in 1937, but no changes of a fundamental nature have been made. The development of the reflection method has been entirely American. S. E. C.

1532.* Brief History of the Gravity Method of Prospecting for Oil. E. A. Eckhardt. *Geophys.*, 1940, **5** (3), 231–242.—The early gravity measurements were made by pendulum. The first gravity survey for oil was probably that made by Eötvös Balance over the Egbell (Czechoslovakia) field in 1916. The first torsion balances in the U.S.A. were imported in 1922, and the first oil structure discovered by the method was the Nash Dome in 1924. An intensive campaign of torsion-balance surveys followed, and this lasted until the end of 1936. After that it fell off, and the amount of torsion-balance work now being done in the U.S.A. is negligible.

Pendulum measurements and anomalies observed in mountainous areas led to the theory of isostasy. The first pendulum survey for prospecting purposes was carried out in Kansas and Oklahoma in 1925–26. Improvements designed to increase precision led to the development of minimum-period pendulums constructed of fused quartz. However, whilst the pendulum has the advantage of speed and insensitivity to local surface irregularities as compared with the torsion balance, the best equipment has a probable error of 0·25 mg. in routine work and requires considerable skill to operate it. As a result, the gravimeter was developed, and the number of gravimeter parties in the field of stations observed have rapidly increased. S. E. C.

1533.* Typical Electrical Prospecting Methods. W. M. Rust. *Geophys.*, 1940, **5** (3), 243–249.—The measurement of natural earth potentials, apart from its use in electrical well logging, is more applicable to the search for metallic ores than petroleum. The basic direct-current method is the equi-potential map method, and various modifications of this are in use. Low-frequency alternating-current methods are essentially the same as direct-current methods.

Sundberg's electromagnetic method, in which the field is induced by moderately high-frequency alternating current, has been successful in prospecting for ores, but has not received general approval in petroleum prospecting.

Many experiments have been made, especially in Germany, on the use of radio waves for prospecting. Theory indicates that, except in very arid regions, the effective depth of penetration is very small, and at present there is not sufficient data to justify optimistic hopes.

Transient methods involve the use of a rapidly changing direct current. Theoretically these methods should give all the information which can be supplied by electrical methods, but, in general, they have received no wider acceptance in petroleum prospecting than the other electrical methods.

The most favourable sign for electrical prospecting for petroleum is the evidence which is accumulating to support the theory of secondary effects in the upper strata over a deposit of oil and gas. S. E. C.

1534.* Fifteen Years of Geophysics; a Chapter in the Exploration of the United States and Canada, 1924–39. J. B. Macelwane. *Geophys.*, 1940, **5** (3), 250–258.—Discovery of oil-bearing structures by geophysical methods began in 1924, and opened a new era of geophysics in America. 1925–29 was a period of rapid expansion of seismic refraction reconnaissance. The reflection method was introduced in the Mid-Continent in 1929, and its use became general in the Gulf Coast in 1932. The magnetic method came into extensive use in 1927, but its popularity for oil work has waned since 1930. The application of gravitational methods falls into two periods: the torsion balance era from 1924 to 1937 and the gravimeter era from 1938 to the present. Electrical methods have been most useful in the mining field. S. E. C.

1535.* A Perspective of Exploration for Petroleum. E. E. Rosaire. *Geophys.*, 1940, **5** (3), 259–271.—The first prospecting technique was based on the recognition of visible seeps of oil and gas, and was rational and direct. Its exhaustive application led to diminishing returns. Geological prospecting followed, and resulted finally in structural prospecting. Then diminishing returns again ensued. Geophysical prospecting, which appeared on the scene in 1923, finally took on an aspect of structural prospecting and led to a renaissance of that method. In both its geological and geophysical aspects it is a rational but indirect method. Its exhaustive application is leading to diminishing returns. The success of the structural method has stifled the natural development of geochemical prospecting from geological prospecting, and has directed geophysical prospecting into an unduly narrow path. Geochemical prospecting, which depends on the chemical and physical measurements of one or more of the geochemical manifestations of a petroleum deposit, is a rational and direct approach to petroleum exploration and, in its turn, will revolutionize prospecting to at least the extent of the previous methods. S. E. C.

1536.* Some Neglected Aspects of Chemical Exploration. R. T. Sanderson. *Geophys.*, 1940, **5** (3), 284–294.—Soil analysis, to be of value, should measure the concentration of hydrocarbons leaking to the surface. The difficulties in making such measurements, as distinct from merely detecting the presence of hydrocarbons in the soil, are indicated, and it is pointed out that in the first place the accuracy of the analysis is not certain and, secondly, that on account of differences in soils and conditions of sorption, the interpretation of such results is even more difficult. The solution of these problems may be very difficult, and it is suggested that a return to the earlier method of soil-gas analysis would overcome many troubles. S. E. C.

1537.* Partnership between Geology and Geophysics in Prospecting for Oil. E. A. Eckhardt. *Geophys.*, 1940, **5** (3), 209–214.—The presidential address at a joint meeting of the Society of Exploration Geophysicists and the American Association of Petroleum Geologists.

A mutual understanding, at present insufficiently developed, should exist between geologists and geophysicists in order that the two sciences may be co-ordinated and produce the best results. In the past, geophysical data have been better than the use which has been made of them. The success of geophysical prospecting depends on the co-operation of executives, geologists, and geophysicists.

The best results in research and development are to be obtained by judicious and continual transfer of men between field operations and research and development work. S. E. C.

1538.* Well Logging by Radioactivity. W. G. Green and R. E. Fearon. *Geophys.*, 1940, **5** (3), 272–283.—The amount of radioactive material deposited in a sediment depends on the nature of the fragments of primary rock and on the remains of small marine organisms which are deposited. It is believed that certain micro-organisms have the ability to concentrate radioactive elements. In general, therefore, a higher radioactive level is to be expected in shales than in limestones or sandstones. More important, however, is the fact that the levels of radioactivity in any one section carry over a considerable area.

There is evidence which indicates that the gamma-ray method of logging may prove to be better than any other method for tracing the continuity of strata over long

distances. Definite contrasts can be observed in shales, and unconformities can be located without reference to other wells. It is possible that the same may be true of faults.

The recording apparatus is based on the measurement of gamma rays by means of an ionization chamber. The penetrative power of gamma rays is so great that logs can be made in wells lined with two or three strings of casing of normal thickness.

S. E. C.

1539.* Formulas and Curves for the Interpretation of Certain Two-dimensional Magnetic and Gravitational Anomalies. H. H. Pentz. *Geophys.*, 1940, **5** (3), 295–306.—Two cases are considered: the two-dimensional "dike" and the two-dimensional "step". Curves are given which provide an easy solution of anomalies due to such structures. S. E. C.

Drilling.

1540.* Drilling in Trinidad. R. G. Bennett. *Petrol. Engr*, October 1940, **12** (1), 58.—Rotary rigs are used on all drilling operations in the southern portion of Trinidad, where most of the oil is at present found. These rigs range from the heavy-duty, four-speed, locally-unitized, old-headboard type, Diesel rigs to small 1500-ft. gasoline-driven rigs.

The average depth of most wells is between 3000 and 4000 ft., although good production has been obtained from shallow depths of 1000–1500 ft. The deepest well drilled was slightly in excess of 10,000 ft. in depth.

The time taken to drill these wells is somewhat long, because of steeply dipping strata and frequent changes of formations, making it difficult to maintain a straight hole. The holes are, however, almost vertical, and the maximum deviation is not more than 3° off at bottom of 3000-ft. wells. Frequent round trips are necessary for changing bits where thin, hard strata are met intermediate with clays and sand, and this adds considerably to drilling times.

The mud problem is a difficult one, but a central mud system, with specialized mud engineers in constant attendance and control, appears to have solved it. Any type of mud as regards weight and colloidal properties may be obtained from these central plants at any time during day or night. The mud engineer is entirely responsible for the type and weight of mud to be used on the various rigs. This fact gives confidence to the driller and helps better drilling practices. Mud weight of 110 lbs./cu. ft. is usual, and on heaving shales being met the weight is sometimes increased to 120 lbs./cu. ft. A. H. N.

1541.* Cementing Casing Under Adverse Conditions. W. A. Sawdon. *Petrol. Engr*, October 1940, **12** (1), 67.—The paper deals with cementing practices and difficulties met on oilfields which are outside the U.S.A., where supplies and tools are limited in variety, and where ingenuity and skill must fill the gaps thus created to obtain successful cementing jobs.

The properties of cement and the effects of such variables as the water–cement ratio, temperatures and pressures on the setting time and the strength of the cement are discussed. Increasing the water–cement ratio will lengthen the thickening time considerably, and it is frequently possible to use a ratio that will give the necessary thickening rate without excessively decreasing the ultimate strength of the cement. The effect of pressure on cement is favourable under almost every condition, and is of particular advantage when high water–cement ratios have to be used. The extra requirements for water when using bentonite with cement are discussed. Thus a widely used water–cement ratio for neat cement is 5·5 gals./sack of cement; but if 5 lb. of prepared bentonite is to be added to make a gel-cement, the total water content in the mix should be about 8·5 gals./sack of cement. Mixing heavy materials with cement to increase its weight is not a general practice, but a recent admixture consists of a treated metallic substance which tends to impart mobility as well as weight to the slurry.

Various methods of cementing are described and illustrated, and the problem of removing the mud sheath from the walls of the hole is discussed. A. H. N.

1542.* Mud Characteristics and Drilling Efficiency. W. A. Sawdon. *Petrol. Engr*, October 1940, **12** (1), 90.—The study of mud characteristics and application is becoming increasingly a province of the chemical engineer, as mud control embraces the use of many chemical ingredients to obtain the appropriate mixture. The paper discusses the weight and colloidal requirements of drilling muds and methods of testing and controlling them.

After a review of the qualities and tests required, it is concluded that these vary so much throughout the fields all over the world that no general rule could be formulated for mud control in every case. Complete testing and conditioning are not always possible, but there are certain qualities of the mud that should be given greatest consideration after evaluating the importance of the different properties. Even the transportation of the basic clay, the mixing, and other factors are often serious problems in certain remote districts.

In controlling one property of the mud—say weight—it must not be forgotten that other qualities in the mud may have a definite bearing on that property—weight in this case—to make it effective. Thus in many fields greater weight is probably used than would be necessary if other properties of the mud were properly maintained.

In addition to the usual tests, which are discussed, the sand content should sometimes be determined. The sand content is usually reported in volume % of approximately 200-mesh sand. The salt content of the fluid is sometimes determined by titration with silver nitrate and reported in grains/gal. A. H. N.

1543.* Clean-out Devices Actuated by Hydrostatic Pressure Facilitate Fishing Operations. W. A. Sawdon. *Petrol. Engr*, October 1940, **12** (1), 109.—Hydraulic bailers are studied, with particular regard to their use for fishing out small objects from the bottom of a well. Each bailer or fishing-tool consists in general of an air- or suction-chamber containing air at atmospheric pressure; a means for suddenly opening a valve into this chamber when the tool has reached the desired position; a load-receiving chamber, and a bottom in which is positioned a flapper-valve to hold the load until the equipment returns to the surface, where it may be dumped. The working of the tool is detailed and illustrated.

Three general designs are described: the rod, the disc, and the valve-section types. The bailer was originally designed for removing sand, mud, and other detrital material from the hole, but is now further used for fishing and for perforation-washing. The perforation in wire-wrapped screen is usually so small that it is almost impossible to pull sand from behind it. It is therefore necessary, to drive the sand away from the wall of the liner. This can be accomplished by allowing the air-chamber to fill from a point above a packer supported by slips. The fluid column is thus given a velocity downward, and this velocity is suddenly checked when the air-chamber is filled. The pressure waves set up in the fluid are stopped at the packer and diverted through the screen against the formation. A. H. N.

1544.* Pre-packed Liners Broaden Scope of Gravel-Packing Applications. W. A. Sawdon. *Petrol. Engr*, October 1940, **12** (1), 118.—The method of packing liners with gravel by circulation after the pipe is set in place is briefly described and illustrated. The pre-packed liner is run into the well in lieu of conventional slotted, perforated, or screened pipe. It can be set opposite one or more productive zones, and intermediate strata in multiple-zone completions can be cemented off. Gravel-packing by either method is used where the well is making too much sand.

Four designs of pre-packed liners are described. A recent type is made with a drillable metal gravel retainer supplied with vertical slots. This type has drillable metal end-collars, which are not welded to the pipe but are attached by set-screws. It is particularly adaptable for use on flush-joint liners. The purpose of the drillable metal outer covering is to provide for drilling-up with wash-over equipment if subsequent conditions make it desirable..

Gravel size should be governed by the formation sand, and it has been the practice either to analyze the sand at the well or to send it to the manufacturer of the liner. Outside the U.S.A. the size of the gravel mostly used has been from 0·093 to 0·110-in. or 0·110 to 0·131-in. In California gravel of smaller size has been used, with the

smallest reported being 0·075 to 0·093-in. All gravel should have high strength, be acid resistant, and of proper size and shape.

Dimensions and other details are given for setting pre-packed liners and cementing intermediate formations. A. H. N.

1545.* Close Control of Verticality Reduces Drilling Time and Cost. W. A. Sawdon. *Petrol. Engr*, October 1940, **12** (1), 123.—One of the principal objectives of controlled vertical drilling is to obtain the use of the most efficient speed and weight on the bit over the greatest possible percentage of the total depth to which the hole is being drilled. The control is accomplished by using accurate instruments for indicating the weight carried on the bit, the speed of rotation, and the mud-pump pressure; and by frequent, properly spaced, accurate checks of the inclination of the hole. Certain operators during the last two years have increased the rotating speed and reduced the weight, with a resultant increase of hole-making speed and less tendency to deviate from the vertical. Procedure for inclination readings determination is outlined.

Citing a deep well as an example of controlled vertical drilling, one such well that was drilled to a depth of nearly 13,000 ft. in California was completed with a maximum deviation of only 1° 15′, and with the final reading taken at 12,000 ft. recording zero. It is believed that this well at this great depth was completed within the area directly below the derrick floor. Details of weight on bit and procedure of drilling and controlling the deviation of this particular well are given.

Due to the fear that long drill-collars may flex, certain operators prefer to use stabilizers below and above a comparatively short drill-collar to attain a vertical hole. If the well is brought back to vertical after only small angles of inclination, trouble is generally a minimum, as the drill string acts as a plumb bob. A. H. N.

1546.* Purpose of Drilling Fluid Used in Rotary Wells. H. F. Simons. *Oil Gas J.*, 26.9.40, **39** (20), 46–48.—There can be no all-purpose drilling mud, because the tasks imposed on the mud are different in each well and with each operator. In one case the mud may be designed primarily to increase the rate of penetration, in another it may be to prevent blow-outs, and in a third case it may be to prevent caving. The best mud in any case is the one which will allow drilling to proceed as rapidly as possible with the minimum possibility of trouble.

The tendency at this time is to develop a mud plan for each particular field, the objects being to reduce the cost and time required to drill a well and the elimination of difficulties while working in the hole. The problem is strictly an economical one, although all the items involved are difficult to evaluate.

In addition to the primary purpose of the mud to remove cuttings from the hole, the mud must also: (1) prevent blow-outs; (2) keep the fluid from entering the formation penetrated; (3) suspend the cuttings in the hole while the pump is shut down; (4) eliminate caving of the hole; (5) reduce the weight of the drill-pipe or the casing to be handled by the hoist; and (6) clean, cool, and lubricate the bit. Settling of the cuttings from the mud in the pits must also be easy. These items are briefly discussed.

Mud systems and types of pits are discussed in greater detail, and a diagram illustrates one type of mud-pits with a baffle which forces the mud to go underneath it. The carrying power of streams is stated to be in proportion to the sixth power of the speed, but in actual practice is often found to vary more nearly with lower powers, even as low as the square of the speed. Yet even at these low carrying powers speeds should evidently be as slow as possible in pits if sand and other cuttings are to be removed. A. H. N.

1547.* Surface and Mechanical Factors Affecting Drilling Fluids. H. F. Simons. *Oil Gas J.*, 10.10.40, **39** (22), 88.—In this second of a series of papers on rotary drilling muds, mechanical equipment used in preparing and maintaining adequate mud supplies is discussed, together with the quantity of mud needed and the work of the mud pumps and factors affecting the quality of the mud.

The use of jets in pits is illustrated and the addition of water to mud is treated in detail, with particular emphasis on the harm done by allowing the mud to lose too

much water and then adding considerable quantities of fresh water in sudden and excessive operations. Degassing muds should be done by a positive and an independent method, and not be left entirely to the screens. Similar studies are made and cautions given regarding the colloidal material of the mud and its control and maintenance.

The hopper-type mud-mixers are fully described and a drawing is given of a typical unit. In adding admixtures to the mud *via* the mixers, the rate of addition should be as slow as practicable, and not in sudden batches of excessive quantities.

The quantity of mud circulated in the system will depend on the size and condition of the pits and depth, size and condition of the hole. A formula is given for calculation purposes. Similarly the power required by the pumps is discussed and typical figures of pressures are given.

A bibliography is appended. A. H. N.

1548.* Bulk-Type Oil-Well Cementing. Anon. *Oil Wkly*, 30.9.40, **99** (4), 20–21.—This new method of handling, storing, and transporting cement to the wells is presented pictorially with short explanations. Several advantages are claimed for it. Spoilage of the cement by weather during the period it was formerly stacked in sacks on the ground at the well location is eliminated, as is waste due to breakage of sacks while mixing the cement. It is claimed that bulk cementing provides more uniform and faster rate of feeding into the mixer than is possible by the conventional method. The equivalent of 1500 sacks of cement were mixed in a certain case in 31½ min.

A. H. N.

1549.* Increased Foundation Height Eliminates Drilling Cellar. Anon. *Oil Wkly*, 14.10.40, **99** (6), 24–25.—The derrick floor is 14 ft. above a heavy concrete mat which acts as a ground-level foundation in this type of rig which has no cellar. The concrete mat supporting the derrick and substructure is 14 in. thick, and concrete piers support the engine foundations.

An advanced feature on the derrick floor is the use of an hydraulic-type brake which disengages while drill-pipe is being pulled out from the hole, thus saving brake lining and shop-work on the drum-shaft.

All blow-out equipment is above ground level, and this constitutes a marked advantage over those installed in cellars. A. H. N.

1550.* Directional Drilling. W. A. Sawdon. *Petrol. Engr*, October 1940, **12** (1), 42.—Directional drilling is employed for two general purposes: (1) for drilling new wells which cannot be located directly above the desired completion point on the productive zone because of economic, topographical, or structural conditions; and (2) for reconditioning or bringing back to production old wells by abandoning a portion of the hole and deflecting it to a different position in the producing zone. These two general classes are detailed by citing examples of drilling for locations under water, or under man-made obstructions like buildings, or for such structural conditions as exist in drilling for the exploitation of flanks of salt domes.

Methods and equipment are briefly reviewed. Whipstocks are used almost exclusively for changing angle and direction, except with slight changes that can be made without mechanical means, and single-shot instruments recording both angle and direction in a horizontal plane are employed to guide the work. The whipstock is oriented into the well to set at a position determined from the single-shot reading. This causes the bit to start off in the direction desired. By proper procedure all dog-legs in the hole are avoided, and in a hole put down by controlled directional drilling no more trouble should be experienced in running casing than in the average vertically drilled hole. A. H. N.

1551.* Solution of Complete Casing-Strings. W. C. Main. *Petrol. World*, September 1940, **37** (9), 27–30.—The paper describes the method of making up a nomographic chart so that complex casing-strings may be analysed and worked out, and also the manner in which this chart can be used. The chart is based on a paper given before the American Petroleum Institute.

One of the chief factors involved in solutions of casing problems is the mud weight.

For use of this chart the weight must be known within fairly close limits. In proven fields this figure may be obtained beforehand; but in wildcatting it is important that a convenient and rapid method be at hand of checking and altering the amounts of each weight to fit conditions which do not accord with those assumed in the calculations. This is shown to be possible with no delay in setting pipe.

An example is worked out in detail to illustrate the various points discussed. The example requires the design of a string of casing for a depth of 11,200 ft., mud weight of 75 lb. cu. ft., using 7-in. casing and keeping a factor of safety of 1·25 at all critical points. Various combinations of weights and grades are possible, and these are studied and finally a correct combination is chosen. A. H. N.

1552. Drilling. F. J. Spang. U.S.P. 2,216,462, 1.10.40. Appl. 25.2.37. Method and apparatus for die-forging drill-bits for percussion drilling systems.

J. F. P. Farrar. U.S.P. 2,216,468, 1.10.40. Appl. 6.4.38. Method of making a coupling connection for hoses.

H. Hügel. U.S.P. 2,216,554, 1.10.40. Appl. 8.6.39. Spring mechanism for oil-well devices adapted to be operated in bore-holes for recording purposes.

J. Fentress. U.S.P. 2,216,686, 1.10.40. Appl. 7.5.36. Coupling and method of making same for hoses.

G. F. Le Bus. U.S.P. 2,216,819, 8.10.40. Appl. 14.10.38. Removable-end filler for cable-winding devices or drums.

A. C. Hoffman. U.S.P. 2,216,839, 8.10.40. Appl. 15.5.39. Interlocking sleeve-coupling for hose connections.

T. B. Wayne. U.S.P. 2,216,865, 8.10.40. Appl. 18.9.37. Treatment of drilling fluids with an ester of phosphoric acid.

T. H. Stancliff. U.S.P. 2,216,894, 8.10.40. Appl. 12.10.39. Rock-bit of the rotary class.

J. C. Stokes. U.S.P. 2,216,895, 8.10.40. Appl. 6.4.39. Rotary under-reamer actuated by fluid pressure to expand reaming blades.

F. J. Hinderliter. U.S.P. 2,216,945, 8.10.40. Appl. 20.2.39. Upset pipe-joint with special features to minimize the tendency for breakage to occur in the vicinity of the last thread.

T. V. Moore. U.S.P. 2,216,955, 8.10.40. Appl. 24.12.36. Oil-base drilling fluid and method of preparing same. The method consists of stabilizing the fluid by adding sulphuric acid.

B. W. Sewell. U.S.P. 2,216,962, 8.10.40. Appl. 25.11.38. Pressure coring device with valves which close on retracting the barrel.

A. C. Sinclair. U.S.P. 2,216,963, 8.10.40. Appl. 9.10.39. Means for cutting windows in well-casings.

V. M. Vesely. U.S.P. 2,217,147, 8.10.40. Appl. 20.9.39. Bailer bottom element.

J. T. Ledbetter. U.S.P. 2,217,175, 8.10.40. Appl. 20.8.38. Method of testing drilling fluid to determine its ability to prevent loss of liquid to the penetrated formation.

A. W. Gelpcke. U.S.P. 2,217,202, 8.10.40. Appl. 19.10.39. Percussion drill having three spiral bands.

F. F. Hill. U.S.P. 2,217,203, 8.10.40. Appl. 6.7.36. Core-barrel with a ball-valve of the same density as the mud used for drilling.

C. C. Gallgher. U.S.P. 2,217,400, 8.10.40. Appl. 24.4.39. Rope-clamp.

A. E. Krick and W. C. Starkey. U.S.P. 2,217,592, 8.10.40. Appl. 1.8.38. Well-reamer for rotary drilling. A. H. N.

Production.

1553.* Automatic Rod-Line Knock-off Cuts Operating Cost. T. P. Sanders. *Oil Gas J.*, 26.9.40, **39** (20), 67–68; cf. also *Oil Wkly*, 7.10.40, **99** (5), 46.—The task of shutting down wells, including time spent in going to and from the hook-off locations and in waiting for the proper time to disconnect each well, often requires one-half of the pumper's total working time. Since 50% of the revenue from a stripper lease must sometimes go to pay pumpers' wages, it is not uncommon for the job of shutting down wells on a centrally-powered lease to cost 20 to 25 cents/brl. of oil produced. An automatic rod-line knock-off device will therefore save the operator almost 25% of the revenue utilized. The surface effect of pounding in the barrel is utilized in this device. When the barrel is completely full, the rod-line will sag under a weight on the down-stroke. When the barrel is not completely full, then on a part of the downstroke the rod-line is in tension. Thus a weight placed on the rod-line will cause a sag in the rod-line until pounding occurs, when the taut line will raise the line. The weight is made to strike a hinged finger which protrudes downward from a sliding rod placed above the rod-line. Thus the upper rod is forced back, causing the release of a heavy drop-bar, which falls into position on the notched hook-off bar. When the hook-off bar is stopped in this way on the downstroke, the rod-line releases itself by means of a link at the power end of the bar. It is necessary for the pumper to connect the well manually. A. H. N.

1554.* Hydraulic Pumping Cost Data. D. Cox. *Oil Gas J.*, 3.10.40, **39** (21), 37–38.—Figures are given for cost data for hydraulic pumping at rates ranging from 174 to 3190 brls./day. The figures were obtained from the records of eleven hydraulic pumping units, and are neither claimed to be criteria of efficiency nor to be reliable in every case.

The accounting factors involved in the cost figures should include amortization of capital investment, lease-rental expense, depreciation of equipment, depletion of natural oil reserves, production costs such as general expenses on salaries, advisors, etc., prospecting, development, lifting, treating and other miscellaneous field expenses such as lease roads, salt water disposal, housing facilities, etc. In this paper lifting and repair expenses are studied in detail and figures are given for lifting and average repairing costs in dollars. A. H. N.

1555.* Procedure for Cleaning Slotted Liners Developed in California. T. P. Sanders. *Oil Gas J.*, 3.10.40, **39** (21), 40.—A recently introduced procedure for cleaning slotted liners has shown conspicuous success on many of the 180 wells on which it has been used in the Californian fields. This method combines mechanical with hydraulic action.

A patented tool is fitted with a series of narrow blades which are supported by coil-springs controlling the thrusting pressure of the blades. Being free to tilt upward or downward or to retreat into the tool, the blades readily slide in a folding position inside the liner. Each time a blade is in line with a slot it is thrust through the slot in the liner to a distance of 1¼ to 1½ in. beyond the outside diameter of the liner. The design of the blades causes the tool to rotate very slowly as it descends or is pulled out, and a swivel joint prevents this rotation from being transmitted to the sand-line.

In order to obtain a washing action to aid the blades in cleaning the slots, a swab is run immediately above the mechanical tool. Since the use of a swab is often considered dangerous in Californian fields, in case too much sand is drawn into the well, a special type of swab, fitted with a relief valve to limit the vacuum to a safe maximum of value, is incorporated. A. H. N.

1556.* Pumping Set-up Anticipates Future Servicing. Anon. *Oil Wkly*, 30.9.40, **99** (4), 23–24.—A steel-based pumping unit is set on a concrete derrick floor with an elevation flush with the ground level. All flow-lines are recessed into this concrete flooring, and an open concrete-lined cellar provides space for well-head connections and is covered with an easily removable, close-fitting metal grating. Hold-down loops for well-pulling and clean-out tools are installed, and are the only obstacles, with

the exception of the Christmas tree and pumping unit, that rise above the floor of the derrick.

As a majority of these wells respond to agitation, flowing through both the tubing and the casing outlet, connections are made below the ground surface to the casing outlet with the floor-line rising to a point just below the level of the ground.

The lead line from the tubing is made up of two convenient lengths of pipe having a ground-joint union, and dropping a short distance to connect with the flow-line from the casing-head, both using a common line leading to the oil and gas separators at the flow-tank battery.

Details of construction are given. A. H. N.

1557*. Modern Well Studies. Part I. F. Briggs. *Oil Wkly*, 7.10.40, **99** (5), 15.—The first part of this paper deals with the selection of pumping-wells equipment when no dynamometer cards are available for calculation, the calculations being based on the volume rate requirement, depth of well, and properties of fluid. The discussion consists almost entirely of an example which is solved in detail.

Computations of plunger travel are made by means of Rieniet's formula, the derivation of which is given in Part 3 of the paper. From load calculations adequate sizes of sucker-rods and sufficient power requirements from power equipment are calculated.

The methods and operations adopted illustrate the calculations required for choosing the plunger diameter and travel and an operating speed at which the maximum load will be a minimum possible for such travel and volume rate. Methods of adjusting the sucker-rods' diameter, in this case made of two sizes of sucker rods, so that corrosion and load conditions may be met adequately, are detailed. The design of walking-beams should be left in general to the manufacturer, but the requirements are calculated here for the sake of illustration. End loads, shear load at the centre, and bending moments are thus calculated. The gears are designed to withstand the maximum torque imposed by the pumping operation, and finally the horse-power and selection of a prime mover are discussed. The paper is well illustrated. A. H. N.

1558.* Removing Air Pockets with Suction Pumps. F. R. Cozzens. *Oil Wkly*, 7.10.40, **99** (5), 50.—It is sometimes found that certain wells which have been receiving air readily for a considerable period in a stripper lease, refuse to take air even at a pressure of 1000 lb./sq. in. in sufficient quantities to be observed in nearby wells. This fact is believed to be due to sudden release of pressure on the well in a previous repressuring operation which results in water, sludge, and oil rushing in to fill the vacuum, and thus encircling and trapping large volumes of air in various sections of the sand. This air, once surrounded by liquid, appears to be unable to escape of its own accord and can seldom be forced by pressure.

A method found helpful in curing this trouble is to apply vacuum to the well, and thus enable the air in the immediate vicinity of the well to break the bonds imposed on it by the liquids. When the air breaks through to the suction pump, it has been known to register 100 lb./sq. in. or more at the casing-head. Usually one operation on one well is sufficient to clear a large tract of sand of entrapped air; but in certain conglomerate fields where air is entrapped in numerous small pockets vacuum applications to many wells are necessary before all the sand is clear of entrapped air. The average time for breaking up air pockets in a field is 10 days, but wide variations have been observed. A. H. N.

1559.* Modern Well Studies. Part II. F. Briggs. *Oil Wkly*, 14.10.40, **99** (6), 26.—This part of the paper deals with instruments used in well studies.

Surface dynamometers are of three types: mechanical, hydraulic, and electrical strain gauge. These three types are well illustrated by photographs and line drawings, and their action and characteristics are explained in detail. The mechanical type measures the stretch in the polished rod at every part of the cycle, and a stylus records this stretch on a drum-chart which is synchronous with the stroke-cycle. In the hydraulic type a part of the load acting on the polished rod is transmitted to a pressure-chamber and the variation in the pressure is impressed upon the recording mechanism by means of fluid in a flexible hose. In electrical dynamometer, an oscillograph

responds to the stretch in the polished rod, and a recorder, which may be taken a considerable distance from the strain-gauge, records the load and the part of the cycle in which it occurs.

A bottom-hole dynagraph is similarly detailed, and a typical card illustrates various parts of its operation. The record is of the stretch of the rod connected to the plunger at every part of the stroke-cycle.

Finally, bottom-hole pressure gauges and a fluid-level determining device are described and their actions are discussed. Either one or the other may be used for measuring the pressure at the sand-face. A. H. N.

1560.* Primary and Secondary Recovery Methods. H. L. Flood. *Petrol. Engr*, October 1940, **12** (1), 39–40.—A short review is given of the application of primary and secondary recovery methods in the field. Recovery methods are classified under three headings: normal, primary, and secondary. Normal methods are considered to include all the devices and measures which may be employed to obtain as much oil or gas from a formation as possible without resorting to any artificial method of replacing, displacing, or augmenting the natural contents of the reservoir. Normal methods thus include natural flow, pumping, and gas-lift—the last being included because the lifting effects on the oil are confined to the well-bore and do not affect the reservoir.

Primary recovery methods embrace all methods which may be instituted during the early life of a field to increase the total amount of oil recovered from the reservoir above the volume which would be yielded if only normal recovery methods had been employed. Repressuring by gas or water drives in the early stages of a field are considered as primary recovery methods.

Secondary recovery methods are similar methods to the primary ones, except that they are applied in the latter stages of the life of a field. The difference in the two methods is not merely a matter of time, but also a difference in the extent to which pressures have been allowed to drop. A. H. N.

1561.* Use of Acids and Other Chemicals in Oil-Production Problems. H. L. Flood. *Petrol. Engr*, October 1940, **12** (1), 46.—The chief chemical engineering practices found in the production of oil are acid treatment of wells, the use of chemical agents for plugging sands to control or exclude water, the use of substances which reduce the surface tension of water and thus prevent it from displacing the oil in the pores of the sand, the use of various cements and chemicals added to them and chemically removing wax and mud from sand-faces. Recently a new acid has been found successful for demudding sand-faces because it is reactive with the silicates as well as with the carbonates, but is non-injurious to iron and most other metals used in oil-well equipment.

Addition agents are added to this acid to accelerate its action on dolomites and retard it on limestones, to reduce its surface tension, and to enable it to wet or penetrate the oil-soaked zones. The action on the silicates is facilitated by the evolution of hydrofluoric acid from the interaction of this 15% HCl acid on sodium fluoride at the sand-face, thus eliminating the hazard of using HF itself.

Chemicals used to lower the surface tension of water to a figure nearer that of the oil than originally are new in the industry, and the most important of these appear to be certain esters of sodium sulphosuccinic acid, such as the dioctyl, methylamyl, and diamyl esters, and an alkyl sodium naphthalene sulphonate.

Their use in completion so that the oil can easily displace the mud is also discussed. References are given. A. H. N.

1562.* Multiple-Zone Completions. H. L. Flood. *Petrol. Engr*, October 1940, **12** (1), 50.—Multiple-zone completions in which several formations are to be segregated usually require: (1) as many producing channels (tubing-strings, annular spaces, etc.) leading to the well-head as there are formations; (2) packers of appropriate types and design to separate the formations; (3) beans or chokes to control the rate of flow from or to each formation; (4) check-valves when necessary to prevent intercommunications between the formations; and (5) a way of obtaining access to cased-off formations either through the casing or by removing it completely.

Two-zone or three-zone completions predominate in multiple-zone completions;

although four-zone completions are possible, they involve additional complications. The size of the hole sets an upper limit to the number of completions, because of requirement (1) above.

Currently, greatest interest is being shown in the use of multiple-zone completions in the deep producing wells of Texas and Louisiana, particularly in distillate fields where it is necessary to return gas to the formation as an essential part of efficient exploitation of the distillate-type of reservoir. The considerable expense of drilling wells to depths of 8000 to 11,000 ft. to serve only as input wells has prompted operators to develop a method of using a single well for the dual purposes of producing distillate and of returning the stripped gas to the formation.

It is expected that multiple-zone completions may be employed in the future to use high-pressure gas or water to repressure an oil formation or to build a water-drive in the oil reservoir. A. H. N.

1563.* Pressure Data Obtained with Formation-Tester. W. A. Sawdon. *Petrol Engr*, October 1940, **12** (1), 55.—The normal method of formation-testing for fluids is described and illustrated. In certain recent methods pressure data are taken and the record kept for future zone. Thus in an area with three producing sands, the uppermost sand being of lowest pressure, and lowest sand possessing the highest formation pressure, the well was completed to produce from the lowest sand only until the pressure in this sand decreased to a value equal to that in the intermediate sand. The intermediate sand was then tapped by gun perforation, and the two sands continued to flow simultaneously until the pressure decreased to the value obtaining in the third sand, which was similarly perforated. The well then produced from all three sands. Other studies of the value of pressure records obtained during testing formations are made in conjunction with core analysis, and these studies prove to be extremely valuable.

Formation-testing is also used in connection with water shut-offs, and routine tests are outlined. These tests are further checked by pressure records, and also by analysis of the salinity of the water. The three tests thus made can ensure a perfect shut-off job; otherwise a failure would be traced in a more certain manner.

The formation-tester may be used, in this connection, for testing water shut-offs when the cement job has been done above the shoe, as in the case of cementing combination strings or blank casing or liner sections between producing zones. The procedure is described, and involves only perforation near the cement parts as an additional step. A. H. N.

1564.* Analysis of Well Performance as Basis for Gas-Lift Operation. H. L. Flood. *Petrol. Engr*, October 1940, **12** (1), 104.—Gas-lift operations are reviewed. The outstanding trend in recent times appears to be a stress on the importance of intelligent analysis of well performance, both before and after gas-lift installation has been made, and not a change in the basis of design of gas-lift.

The more important basic well characteristics which influence the design and performance of a specific gas-lift installation appear to be: (1) reservoir or static pressure; (2) productivity index; (3) formation gas–oil ratio; (4) per cent. water; (5) depth; (6) size and condition of casing; and (7) size and condition of liner.

A factor which is assuming an increasing degree of importance is the back pressure imposed against the face of the formation, and to reduce this pressure a number of devices have been evolved. The usual method of isolating the formation from the back pressure is to employ a sub-packer type of installation which consists of a packer to seal off the casing and a standing valve in the lower end of the tubing or chamber.

Flow-valves for intermitting systems are studied in a general manner. An interesting innovation is the installation of bottom-hole chokes or discs in the lower end of tubing string to control the rate of oil entering the tubing, so that the allowed daily production will be obtained in a steady flow throughout the 24 hours. The system is detailed. A. H. N.

1565.* Gun-Perforating Technique in Production Problems. W. A. Sawdon. *Petrol. Engr*, October 1940, **12** (1), 114.—The bullets most widely used in gun-perforating oil-well pipes are from 0·45 in. to 0·50 in. in diameter; smaller and larger sizes than these are available for special jobs. The sharp-nose-type bullet creates a hole as

nearly clean cut as possible through the pipe and is used most generally; but operators occasionally use a type of bullet which tends to rip the liner as it penetrates through.

Various gun-perforating practices connected with selective completion of sands are described. Squeeze-cementing jobs which require gun-perforations are briefly mentioned. An illustration shows tubing gun-perforated to admit gas from the annulus between tubing and open hole which contains a gas sand overlying shale and an oil sand, the shale being packed off with an open-hole packer; thus the gas from the overlying sand helps in lifting the oil from the lower oil sand.

Gun-perforating of limestone formations before acidizing has resulted consistently in an increased production, as compared with similar offset wells which have been similarly acidized, with the exception that in the procedure they were not perforated first. The bullets fracture the lime and provide a greater surface on which the acid can act. Although specific well conditions govern the spacing of perforations, it is found good practice to space holes approximately 1 ft. apart for this work.

Production has been increased, or re-established when lost, on perforating badly clogged liners. A. H. N.

1566.* Pressure Distribution about a Slotted Liner in a Producing Oil Well. Part II. F. G. Miller. *Petrol. Engr*, October 1940, **12** (1), 134.—In this part experimental procedure and results are given for the pressure losses in the vicinity of a slot for various rates of flow. The graphs of the head loss are curves, and not strictly straight lines.

Experiments on an electrical model of the system are then detailed. Six copper strips, representing slots in a liner, were used in an electrolyte, and the voltage drop per unit rate of current-flow represented the pressure drop per unit rate of water-flow in the permeability tests. The theory of the analogy is worked out and the formulæ are given in detail. The flow in the electrical model was made two-dimensional in three strips and three-dimensional in the other three. The graphs are straight lines.

The last part of this section of the paper deals with the combination of fluid-flow and electrical analogy results. The dimensional similarity is first shown. As the electrolytic-conduction system was geometrically similar to the fluid-flow system, ratios from one system could be applied in computing the value of variables in the other. Thus the ratio of voltage drop to the product of current and conductivity in the electrolytic model is directly used for calculating the pressure drop in a similar slot in the fluid-flow system. The difference in this value of pressure drop and the actual pressure drop is taken to be the loss in head due to convergence of the stream-lines and turbulence just outside the slot. Similar calculations made on the other slots are tabulated.

Other parts of the paper will be published later; hence no conclusions are possible in this abstract. A. H. N.

1567.* Selecting a Casing and Tubing Programme. J. E. Brantly. *Petrol. World*, September 1940, **37** (9), 31–32.—The selection of the correct tubing size to be used is dependent on the rate of production, depth of oil horizon, bottom-hole pressure and temperature, density, viscosity and surface tension of the oil-gas mixture, the effect of gravity and the pressure loss per unit length, and the artificial lifting method to be used after the flow has ceased. No formula is known to take all these factors into consideration. Trial-and-error methods are still the only rules.

A single problem is discussed in detail to show the effects of certain of these conditions on the selection of tubing. It is shown in this problem that tubings of larger sizes than that selected add nothing to the efficiency of production under the maximum allowable rate assumed, and are not justified.

Having selected the tubing size, a satisfactory casing diameter must be chosen. The manner of choosing such a diameter is similarly shown by solving for the same problem.

It is pointed out that if casing sizes were generally reduced and internal flush joint-drill pipes more generally used there would be a saving on salvaging the drill pipe and using it as a casing. Similarly externally upset tubing could be used for drilling. A. H. N.

1568.* Must we Look for a New Reservoir Control? S. C. Herold. *Petrol. World*, September 1940, **37** (9), 55–56.—Dr. Herold assumes knowledge of the principles discussed in his book on production of oil, gas, and water, and points out the three controls described: hydraulic, volumetric, and capillary controls. Hydraulic control is taken here to be a special case of volumetric control, as in the latter rain-water does not enter the field in sufficient quantities to replace the fluids produced, whilst in the former entry of rain-water and production of fluids proceed at the same rate. Thus the problem of controls is reduced to two types: volumetric and capillary.

In volumetric control the rate of production is proportional to the square root of the effective working pressure—*i.e.*, the difference between the closed-in pressure and the back pressure against which production takes place. In capillary controls, the rate of production is proportional to the power $\frac{1}{2}$ of the effective working pressure. The question raised by the paper is whether there is a third control, intermediate between volumetric and capillary, where the rate of production is linear with the effective working pressure.

No solution to the problem is given, but it is pointed out that work based on Darcy's Law assumes such a control. It is not argued that such a system is not possible; it is merely indicated that this should be proved without delay. A system of fluid mechanics should be solved in a complete form based on this law of flow.

Two equations are primarily necessary, the first already stated—*i.e.*, rate of production—is proportional to the first power of effective working pressure. The second equation must involve time as a function of delivery, and this requires experimentation. It is contended that experiments with a block of sandstone represents not a reservoir, but an orifice. Experiments with a long tube of sands are suggested to approximate more nearly a natural reservoir. A. H. N.

1569. Method for Determining the Water Content of Oil-Sands. D. B. Taliaferro and G. B. Spencer. U.S. Bur. Mines. Report of Investigations No. 3535. September 1940.—The authors of this paper accentuate the importance of being able accurately to estimate total water content of oil-sands. Such calculations have a direct bearing on estimations of total oil in place per unit of reservoir volume; on efficiency of oil recovery by common production methods; and on the dynamics of reservoir behaviour.

Petroleum engineers have from time to time evolved satisfactory methods of determining the water content of products, but, owing to the presence of crude oil and water of crystallization in oil-sands, these methods have not been generally applicable to core specimens. Recently, however, the Bureau of Mines has adopted a modification of the A.S.T.M. method for determining water in petroleum products to ascertain the water content of oil-sands. Departures from A.S.T.M. procedure include alteration in size and shape of the trap to facilitate reading of the volume of water collected; replacements of corks by ground-joints; and the use of toluene as a solvent in place of gasolene.

The chief advantages of the method described are its accuracy, simplicity, and low cost of equipment. Moreover, the method is especially suitable for the small samples on which the staff of all core laboratories have to work. H. B. M.

1570. Production. G. F. Turechek. U.S.P. 2,216,144, 1.10.40. Appl. 8.3.39. Sealing-disc for gun-perforators.

G. F. Turechek. U.S.P. 2,216,145, 1.10.40. Appl. 8.5.39. Gun-perforator for well-casings.

B. Barnum. U.S.P. 2,216,151, 1.10.40. Appl. 8.5.39. Gun-type casing perforator with a special type of bullets.

A. C. Fritsche. U.S.P. 2,216,268, 1.10.40. Appl. 29.1.37. Method and means for testing wells utilizing a removable packer and fluid under pressure to indicate loss of pressure.

C. R. Anderson. U.S.P. 2,216,288, 1.10.40. Appl. 26.4.38. Pipe perforating device for shop-perforating jobs.

F. J. Svoboda. U.S.P. 2,216,302, 1.10.40. Appl. 2.5.38. **Pipe perforating** device applied to outside of pipe.

C. H. Barnes and J. Young, Jr. U.S.P. 2,216,336, 1.10.40. Appl. 15.7.39. Multiple ring-packer.

L. Spencer. U.S.P. 2,216,358, 1.10.40. Appl. 24.12.38. Well-packer with multiplicity of packing-rings which are compressible to expand radially.

L. Spencer. U.S.P. 2,216,359, 1.10.40. Appl. 22.5.39. Gun-perforator for oil-wells.

E. C. Wolferz. U.S.P. 2,216,481, 1.10.40. Appl. 12.11.38. Coupler for pipes.

M. Miller and L. N. Davis. U.S.P. 2,216,674, 1.10.40. Appl. 11.6.39. Well-cleaner with a scraper.

M. B. Thomas. U.S.P. 2,216,967, 8.10.40. Appl. 18.2.38. Gas-lift valve with means sensitive only to the gravity of the fluid for fixing the position of the valve.

T. R. Alley. U.S.P. 2,217,038, 8.10.40. Appl. 20.5.38. Tiltable ring-packer with concave annular plates of packing material.

A. Boynton. U.S.P. 2,217,043, 8.10.40. Appl. 4.10.38. Well-testing tool with packer and a drill stem releasably connected to the shell.

C. J. Coberly. U.S.P. 2,217,215, 8.10.40. Appl. 24.1.38. Gravel-packing for wells, the wells having sand-grains in the walls thereof.

J. F. Sisson. U.S.P. 2,217,238, 8.10.40. Appl. 15.4.39. Sucker-rod wrench for oil-wells.

T. E. Bryan. U.S.P. 2,217,305, 8.10.40. Appl. 24.1.38. Apparatus for removing liquids from wells with intermitter valve.

G. A. Zeidler. U.S.P. 2,217,327, 8.10.40. Appl. 17.9.38. Method of producing well-screens.

N. Johnston. U.S.P. 2,217,370, 8.10.40. Appl. 8.8.39. Screen-wrapped perforated-liner-pipe for oil- and water-wells.

See also Abstract No. 1529.

Gas.

1571. Patent on Gas. E. L. Hall. U.S.P. 2,217,250, 8.10.40. Appl. 4.11.38. Improvement in the production of gas and by-products from petroleum oils by pyrolysis in intermittently heated checker-work, with removal of and collection of the gas formed and recovery of by-products. H. B. M.

See also Abstract No. 1620.

Hydrogenation.

1572. Patent on Hydrogenation. M. Pier and E. Donath. U.S.P. 2,215,190, 17.9.40. Appl. 21.7.37. Production of hydrocarbon compounds from products obtained by extracting solid carbonaceous materials with organic solvents by adding an organic diluent to the mixture of extract and solvent, subjecting to distillation, and subjecting the remaining mixture of extract and diluent to a treatment with hydrogenating gases. H. B. M.

Polymerization.

1573. Patent on Polymerization. R. M. Deanesly. U.S.P. 2,216,549, 1.10.40. Appl. 16.5.40. Improvement in the process of polymerizing an olefinic C_3 to C_6 hydrocarbon fraction containing impurities naturally associated therewith. H. B. M.

Synthetic Products.

1574. Patent on Synthetic Products. H. E. Potts. E.P. 526,814, 26.9.40. Appl. 11.3.39. Synthesis of hydrocarbons with more than one carbon atom in the molecule from mixtures of carbon monoxide and hydrogen. H. B. M.

Refining and Refinery Plant.

1575.* Condenser-Tube Alloy Tests show Corrosion Conditions Need Study. R. W. Moore and S. Kleinheksel. *Nat. Petrol. News*, 29.5.40, **32** (40), R.186.—In examining the corrosion-resisting properties of a number of alloys in use in condensers, test specimens were inserted at each end of experimental condensers placed in parallel with large condensers at significant points in a refinery. Admiralty metal has been found to be satisfactory under the most severe conditions. It is contended that a study of corrosion conditions and means of remedying them would be valuable, since copper-base alloys, do not show a degree of superiority which would justify their adoption. H. G.

1576.* Filter-Clay Efficiency Affected by Water, Carbon, and Porosity. L. M. Henderson, C. M. Ridgway, and W. B. Ross. *Nat. Petrol. News*, 29.5.40, **32** (24) R.193.—The water present in filter clays is recognized, arbitrarily, as of two types. "Adsorbed" water is removed by heating the clay to 450° F., and "Bound" water by heating to 1800° F. The investigation was carried out on Florida fuller's earth and Pennsylvania cylinder stock and bright stock. Such a clay absorbs moisture from the air at a rate dependent on the temperature, the rate being negligible above 275° F. The humidity of the air is of less significance than the temperature. With clay not previously used the proportion of "bound" water is without effect on the percolation yield, provided the "bound" water content is above 2% and "adsorbed" water is absent. In this investigation clays were recovered after use by burning at 1075° F., and with such clays percolation yield decreased with decrease of bound water—that is, with the number of "burns." Adsorbed water in a clay affects the "haze" of the filtrate, but "bound" water is without effect. The presence of carbon in the clay affects the yield and cast of cylinder stocks of 8 N.P.A. colour, but with 5 N.P.A. bright stock the effect is much smaller. The filter efficiency of Florida clay increases with porosity, inasmuch as the specific area is a function of porosity. H. G.

1577.* Collects Sulphuric Acid Fog by Bubble-Phase Absorption. Anon. *Nat. Petrol. News*, 29.5.40, **32** (24) R.200. *Abstract of Paper by D. W. Bransky and F. F. Diwoky at 10th Mid-Year Meeting of A.P.I. at Fort Worth* 29.5.40.—Sulphuric acid is removed from stack-gases by scrubbing in a bubble-tower with an aqueous solution of a foam-forming substance. The most efficient foam-forming agent consists of the sulphonic acids—"green acid"—derived from acid sludge. A 10% solution is claimed to be efficient in removing 93—95% of the available acid in 10—11 sec. The solution retains its foam-forming efficiency until 10% of acid has been absorbed. H. G.

1578. Patents of Refining and Refinery Plant. A. H. Schutte. E.P. 526,744, 25.9.40. Appl. 27.2.39. Separation of wax from wax oil or wax–wax mixtures by emulsifying the mixture with a non-reactive liquid. The emulsion is thereafter chilled so that the higher-melting-point waxes are solidified, and the remaining constituents are thereafter separated from the solidified waxes.

Aktiebolaget Separator. E.P. 526,852, 26.9.40. Appl. 27.3.39. Continuous refining of oil with alkali characterized in that the oil-containing soap separated from the oil is mixed with oil-containing soap-water separated from the refined oil.

J. G. Fife. E.P. 527,030, 1.10.40. Appl. 28.3.39. Separation of the components of a mixture of polar organic isomeric compounds with the aid of two solvents which are insoluble or only slightly soluble in each other, the components of the mixture distributing themselves in different proportions in the solvents.

N. Levy. E.P. 527,031, 1.10.40. Appl. 28.3.39. Method of production of nitroparaffins in which nitrogen peroxide and one or more paraffins are heated in the gaseous phase in the presence of catalysts consisting of arsenic or antimony or materials containing the same.

Standard Oil Development Co. E.P. 527,299, 7.10.40. Appl. 30.3.39. Process for operating a countercurrent solvent-treating tower containing contacting and distributing means and in which one phase is introduced at the top of the tower and another at the lower portion. Impulses are imparted to the phases in the tower by varying periodically the rate of feed of one or both phases and/or the rate of withdrawal of the phase collecting at the bottom of the tower.

M. W. Kellogg Co. E.P. 527,307, 7.10.40. Appl. 1.4.39. Continuous catalytic conversion of hydrocarbons in vapour phase. The hydrocarbon vapours heated to reaction temperature are passed continuously through a reaction zone filled with a compact bed of granular catalyst. After intimate contact of the hydrocarbons with the catalyst, the latter is continuously withdrawn from the reaction zone, reactivated and returned to the zone.

E. I. Du Pont de Nemours & Co. E.P. 527,316, 7.10.40. Appl. 4.4.39. Production of alcohols by the direct catalytic hydration of olefines in the presence of an aqueous solution of a mineral acid. A dilute alkaline solution is introduced into the alcoholic vapours, and leaves the reaction zone in such proportion that the crude condensate obtained on cooling the vapours has a p_H value of not less than 6·0.

Consortium für Elektrochemische Industrie G.m.b.H. E.P. 527,423, 9.10.40. Appl. 24.9.38. Hydration of vinyl acetylene using acid metal catalysts. The reaction temperature is kept constant at boiling point so that heat is removed by evaporation of the reaction liquid.

A. W. Hixon. U.S.P. 2,216,009, 24.9.40. Appl. 17.12.36. Refining of petroleum oils containing paraffinic and naphthenic constituents by contacting the oil with a solvent having preferential affinity for non-paraffinic constituents of the oil; separating the solvent with the dissolved naphthenic constituents from the undissolved oil constituents; and thereafter contacting the solvent–oil phase with a second solvent which is substantially immiscible with the first solvent. Thereafter the oil fractions are recovered from each oil phase.

S. Musher. U.S.P. 2,216,711, 1.10.40. Appl. 17.11.40. Method of decreasing sludge formation and corrosion tendencies of lubricating oils. The oil is treated with a small amount of lecithin and an aromatic compound selected from the group consisting of polyhydroxy aranes, polyamino aranes, aminohydroxy aranes, monoamino-polynuclear aranes and monohydroxy-polynuclear aranes at an elevated temperature.

G. H. Short, U.S.P. 2,216,856, 8.10.40. Appl. 13.5.38. Stabilization of hydrocarbon oil which has been sweetened with a reagent containing copper by intimately contacting it with an aqueous solution containing ferrocyanide ions.

H. G. Vesterdal. U.S.P. 2,216,968, 8.10.40. Appl. 28.5.38. Refining of heavy hydrocarbon oils by treating with dilute aqueous caustic soda under sufficient pressure to maintain the oil and caustic soda liquid at the operating temperature (300° F.) and below the decomposing temperature of the hydrocarbon oil. Thereafter the dilute caustic soda is removed together with the extracted material by decantation.

W. G. Horsch. U.S.P. 2,217,368, 8.10.40. Appl. 12.3.38. Removal of low-temperature sludge from dielectric mineral oil compositions by adding thereto a substance selected from the group of diphenyl and diphenyloxide. H. B. M.

Chemistry and Physics.

1579. Structure and Energies of Some Hydrocarbon Molecules. J. E. Lennard-Jones and C. A. Coulson. *Trans. Faraday Soc.*, 1939, **35**, 811–823.—The effects of resonance on energy content and interatomic distances are shown in various hydrocarbon

molecules, the structures of which are correlated with these effects. In many cases, especially in conjugated hydrocarbons, the valence electrons must be considered mobile, and free to move throughout the molecule. The consequent modifications of the properties of the links are outlined. Calculations of the energy, order, and length of links are given and tables for various hydrocarbon molecules, including open conjugated chains, condensed rings, and free radicals, are given. Where comparison with experiment is possible, the lengths and energies agree excellently. E. H. W.

1580. Activation Energies of Reactions Envolving Conjugated Systems. M. G. Evans. *Trans. Faraday Soc.*, 1939, **35**, 824–834.—The activation energy of reactions involving conjugated molecules is discussed. It is suggested that the low activation energy for the dimerization and polymerization reactions is due to the large resonance energy in the transition state. The resonance energy is discussed in terms of the behaviour of the mobile electrons in the conjugated systems. E. H. W.

1581. Critique of the Pair Theory of Mesomerism. E. H. Lloyd and W. G. Penney. *Trans. Faraday Soc.*, 1939, **35**, 835–841.—An improved mode of presentation of the theory is given. The type of calculation which may be expected to lead to results of accuracy comparable with experiment is discussed. Mention is made of other types of calculation in which the theory is incapable of yielding such results.

The butadiene, benzene, allene, and diacetylene molecules are discussed in the light of the theory. E. H. W.

1582. Application of the Nitric Oxide Method to the Investigation of Reaction Chains in the Decomposition of Hydrocarbons. L. A. K. Staveley and C. N. Hinshelwood. *Trans. Faraday Soc.*, 1939, **35**, 845–849.—From the retarding effects of small quantities of nitric oxide on the reactions of certain organic compounds, indications are given of the existence of a chain mechanism, and the proportion of molecules taking part in such a mechanism is deduced.

The decomposition of several hydrocarbons have been studied in this way, and there is a discussion on the decomposition of ethane. E. H. W.

1583. Decomposition of Hydrocarbons Induced by Free Radicals. F. O. Rice and O. L. Polly. *Trans. Faraday Soc.*, 1939, **35**, 850–854.—A free radical theory proposed by one of the authors (*J. Amer. Chem. Soc.*, 1931, **53**, 1929; 1934, **56**, 284) is applied to the thermal decomposition of a pure organic compound. The kinetics of the proposed reaction are given. The apparatus used to verify their theory is described and results of an investigation with *n*-butane are given. E. H. W.

1584. Reaction of Hydrogen Atoms with Propane and the Mechanism of the Paraffin Decompositions. E. W. R. Steacie and N. A. P. Parlee. *Trans. Faraday Soc.*, 1939, **35**, 854–860.—The reactions of ethane and ethyl radicals with hydrogen are reviewed and the importance of the reaction $H + C_2H_5 = 2CH_3$ from the standpoint of the Rice theory is emphasized. Experiments on the reaction of hydrogen atoms with propane by the Wood–Bonhoffer method are described. At high temperatures the products of the reaction are methane, ethane, and ethylene, but methane is the only product at low temperatures. The results are discussed, and it is concluded that they offer strong evidence that the reactions $H + C_2H_5 = 2CH_3$ and $H + C_3H_7 = C_2H_4 + CH_3$ occur readily at room temperatures. E. H. W.

1585. Pyrolysis of 2-Carbon and 3-Carbon Paraffin and Olefine Hydrocarbons. M. W. Travers. **Part I. Equilibrium Mixtures.** *Trans. Faraday Soc.*, 1939, **35**, 860–864.—The investigation of the pyrolysis of 2-Carbon hydrocarbons starting with equilibrium mixtures of ethane, ethylene, and hydrogen is described. Similar work was done on propane, propylene, and hydrogen mixtures. Various theories on the production of methane in these reactions are discussed.

Part II. Pure Ethane. M. W. Travers and J. A. Hawkes. *Ibid.*, 864–868.—Continuing their work on these lines, these authors now studied the pyrolysis of ethane using a new technique. Results are given, and it is shown that propylene is not an

important product, as had been claimed by other authors. The primary decomposition is shown to be influenced by the surface. Primary and secondary processes are shown in these experiments to become quickly of equal importance.

Part III. The Influence of Nitric Oxide on the Secondary Decomposition of Ethane. M. W. Travers and J. A. Hawkes. *Ibid.*, 868.—From the results of this investigation the authors show that the theory advanced by Hinshelwood and Staveley on the decomposition of ethane is somewhat unsatisfactory. E. H. W.

1586. Kinetics of the Thermal Decomposition of Tetramethyl Methane (Neopentane). T. J. Gray and M. W. Travers. *Trans. Faraday Soc.*, 1939, **35**, 868–870.—Because of the results obtained on the thermal decomposition of the methylamines, the authors decided to investigate the reaction involved by the compounds obtained by replacing the hydrogen in the methyl group by successive methyl groups. So far only the formation of hydrogen and methane has been measured. Results are discussed, and the work is being continued. E. H. W.

1587. Homogenous Thermal Decomposition of some Cyclic Hydrocarbons. L. Küchler. *Trans. Faraday Soc.*, 1939, **35**, 874–880.—The thermal decompositions of *cyclo*hexane, *cyclo*hexene, and methyl*cyclo*pentane have been investigated. *cyclo*Hexane primarily decomposes in two parts, forming, partly *cyclo*hexene and hydrogen, and partly two molecules of propene. *cyclo*Hexene gives primary products of ethylene and butadiene. The decomposition of methyl*cyclo*pentane is very similar to that of *cyclo*hexane, but detailed analyses are not available here. E. H. W.

1588. Existence of Methylene in Hydrocarbon Reactions. R. F. Barrow, T. G. Pearson, and R. H. Purcell. *Trans. Faraday Soc.*, 1939, **35**, 880–889.—This paper consists of a summary of the available knowledge on the presence of the methylene radical. Its presence having been postulated to account for analytic and kinetic data concerning the decomposition, oxidation, and polymerization of hydrocarbons. Proof has been difficult to obtain, and its existence in these reactions is not yet generally accepted. Particular reference is made to the decomposition of methane. The trend of results leads to the conclusion that methylene radicals are the primary product, reacting readily to give methyl radicals.

The authors conclude that, while the evidence they submit tends to be confusing, methylene has nevertheless been definitely isolated and shown to exist as an intermediate in numerous reactions. There is no experimental proof that methylene contains bivalent carbons, but none of the evidence submitted conflicts with this, and it therefore remains the author's present view. From reactions shown, the rapid disappearance of methylene in systems containing hydrogen and hydrocarbons is explained. E. H. W.

1589. Stability of Hydrocarbon Biradicals and Their Reactions. C. E. H. Bawn and J. Milsted. *Trans. Faraday Soc.*, 1939, **35**, 889–897.—The preparation of methylene and biradicals containing up to six carbon atoms is discussed. The reactions of methylene are noted, including the reaction with hydrogen at 300° C. to give methane. There was no evidence for the formation of ethylidene. The decomposition products of tetra-, penta-, and hexa-methylene radicals are given, and the stability of these compounds is discussed. E. H. W.

1590. Influence of Temperature on the Stability of a Mineral Oil. F. P. Bowden, L. Leben, and D. Tabor. *Trans. Faraday Soc.*, 1939, **35**, 900–904.—These authors show that if a mineral oil is heated in air, compounds are formed in it which improve the lubricating properties. The frictional behaviour is changed from "stick-slip" to continuous sliding, with a consequent reduction in wear.

The rate of formation of these compounds is much more rapid when the oil is in a thin film on a steel plate, than when it is in bulk. The rate of formation of these substances rapidly increases with temperature, until at 300° C. other substances are formed which seriously interfere with the lubricating properties of the mineral oil. The improvements in the lubricating oil by heating are compared with the addition of small amounts of fatty acid. E. H. W.

1591. Polymerization of Hydrocarbons. M. W. Perrin. *Trans. Faraday Soc.*, 1939, **35**, 1062–1067.—The mechanism and behaviour on polymerization of certain unsaturated hydrocarbons are compared, and the differences between them discussed. The correlation of the properties and the molecular structure of certain high-molecular-weight polymers is described. The existence of a three-dimensional or two-dimensional structure is shown to account for the mechanical and thermal behaviour. The detailed constitution of the molecule explains the differences in the elastic properties of the long-chain polymers. E. H. W.

1592. Butadiene Polymers; Elucidation of Structure by Ozonolysis. R. Hill, J. R. Lewis, and J. L. Simonson. *Trans. Faraday Soc.*, 1939, **35**, 1067–1073.—These experimenters obtained succinic acid, butane 1 : 2 : 4-tricarboxylic acid, and resinous acids from the ozonolysis of a butadiene polymer. The polymerization of butadiene in aqueous emulsion is described. It is shown from the results that under these conditions butadiene polymerizes by all the possible additive mechanisms, but a quantitative discrimination between them is not possible. E. H. W.

1593. Butadiene Co-Polymers; Elucidation of Structure by Ozonolysis. R. Hill, J. R. Lewis, and J. L. Simonson. *Trans. Faraday Soc.*, 1939, **35**, 1073–1079.—The formation of a polymer of butadiene and methyl methacrylate in aqueous emulsion is described.

From the ozonolysis of this polymer 2-methyl-1 : 2 : 4-tricarboxylic acid was isolated, thus establishing a co-polymer structure. The products obtained show that more than half of the polymer consists of alternate units of butadiene and methyl methacrylate. The butadiene is shown to polymerize by a 1 : 4 addition. Differences in structure and properties between the co-polymer and the butadiene polymer are correlated. E. H. W.

1594. Patents on Chemistry and Physics of Petroleum. H. Beller. U.S.P. 2,216,222, 1.10.40. Appl. 20.4.38.—Process of oxidizing high-molecular paraffinic hydrocarbons by adding to the initial material a solution of a catalyst in a solvent selected from the group consisting of water, a water-soluble organic solvent, a mixture of water and a water-soluble organic solvent. The ingredients are thereafter mixed, the solvent removed, and the mixture subjected to oxidation by means of an oxidizing gas containing oxygen at an elevated temperature.

R. L. Rude. U.S.P. 2,217,636, 8.10.40. Appl. 24.8.39. Method of effecting a change in a hydrocarbon fluid flowing in a continuous path and interposing in the said path at least one flow-responsive element; determining the weight-rate of flow of the fluid through the element and correlating the manifestation of the flow-responsive element with the weight-rate in order to determine *in situ* the density of the hydrocarbon at the locality of the element. H. B. M.

Motor Fuels.

1595. Patent on Motor Fuel. F. J. Sowa. U.S.P. 2,212,992, 27.8.40. Appl. 22.6.38. Preparation of a fuel for use in internal-combustion engines and consisting of a liquid hydrocarbon fuel and a material selected from the group of compounds consisting of alkyl silicols and alkyl silicyl ethers.

F. W. McCurry. U.S.P. 2,214,749, 17.9.40. Appl. 21.11.38. Preservation of the antiknock value, colour, and transparency of a hydrocarbon motor fuel by incorporating therewith an activated oxidised glyceride in the ratio of one part of the glyceride to 1000 to 80,000 parts of the fuel.

B. H. Lincoln. U.S.P. 2,214,768, 17.9.40. Appl. 5.2.38. Production of a motor fuel consisting of a volatile combustible liquid with a boiling range of the order of commercial gasoline and a small amount of a mixture of substantially less volatile mineral and a halogenated carbon ring compound. H. B. M.

Diesel Fuel.

1596.* Rating of Diesel Fuels. P. H. Schweitzer and J. S. Chandler. *Aut. Eng.*, 1940, **30**, 135–141.—This paper describes tests made on a range of fuels in the C.F.R. laboratory C.I. engine and in a number of high- and low-speed engines to determine whether the laboratory ignition-quality rating is a true index of the performance of a fuel in commercial engines. The test procedure for determining the ignition quality of the fuels was based on the ignition delay criterion, and followed the laboratory procedure as much as possible, and the average of twenty-two ratings by fourteen laboratories on the C.F.R. engine was taken as the reference point for laboratory ratings. Three test methods were used—*viz.*, the R.C.R. method, in which the compression ratio is adjusted until the ignition lag becomes 15°; the air-throttling method, in which the air intake is throttled until a predetermined lag is obtained; and the variable-lag method, in which the engine is operated under normal conditions and blends of reference fuel are determined which give the same lag as the fuel under test. Full details of an improved apparatus for measuring ignition lag are given. This apparatus was developed by Schweitzer and Hetzel in 1935.

The authors conclude that the C.F.R. laboratory method underrates fuels by an average of 3 cetane numbers in comparison with the commercial engines. The average deviation between various commercial engines is about 2 cetane numbers. The accuracy of the variable-lag method is inferior to that of the R.C.R. and air-throttling methods. The type of engine has a greater effect on ratings than the method used to rate the fuels. Commercial engines may be compared by noting the slope of the ignition-lag *v.* ignition-quality curves; the flatter the curve the less sensitive the engine to ignition quality, a flat curve being an advantage in service engines.

C. H. S.

Lubricants and Lubrication.

1597. Evaluation of Lubricating Oils Used in Aeroplane Engines. S. Sintori and F. Pomella. *Olii. Min.*, 1940, **20** (5), 49–52.—The difficulty of obtaining a representative sample is described, as are methods for analysing used aviation oils. The asphalt is determined by precipitation and filtration, the free carbon being subsequently estimated by oxidation in the presence of copper oxide and absorbing the CO_2 formed. The residual ash can then be analysed, if required. In order to determine quantitatively the inorganic constituents, a large sample, 200–300 g., is ashed in a platinum crucible. When burning has finished, sodium and potassium carbonates are added and the organic material is destroyed by heating. Methods are outlined for estimating iron, aluminium, lead, copper, zinc, silica, bromide, and sulphate, a typical analysis being given. The analysis of deposits is dealt with in a similar manner to that employed for used oils, the only difference being the estimation of oil with normal benzine and subsequent estimation of asphalt with boiling benzene. A typical analysis of such a deposit is quoted.

The use of photomicrographs to determine the type of carbon formed and its possibility of obstructing oil-ways is described. This method is used in conjunction with carefully controlled single-cylinder engine tests. The viscosities of these used oils can also be determined after filtration through a Jena G.3. sintered-glass crucible.

H. L. W.

1598. Patents on Lubricants and Lubrication. J. Robinson. U.S.P. 2,215,362, 17.9.40. Appl. 10.3.38. Process of decolorizing viscous lubricating oil by heating a mixture of viscous lubricating oil and liquified normally gaseous hydrocarbon solvent to a temperature corresponding to a solvent vapour pressure in excess of 150 lb. per sq. in. under sufficient pressure to maintain the solvent in liquid state. Thereafter the mixture is passed through a bed of adsorbent decolorizing clay under sufficient pressure to maintain the solution in liquid state.

C. F. Swinehart. U.S.P. 2,215,432, 17.9.40. Appl. 1.6.38. Preparation of a sulphur compound adapted for addition to lubricating oil. This is composed of sulphur, a substance of the group consisting of naphthalene and diphenyl, and an aromatic amine. The amine is present in a smaller proportion than the sulphur.

G. M. Maverick. U.S.P. 2,215,590, 24.9.40. Appl. 20.7.35. Preparation of a lubricating composition containing a major proportion of a viscous hydrocarbon lubricating oil and a minor proportion of a phthalic ester.

J. F. Nelson. U.S.P. 2,215,591, 24.9.40. Appl. 20.5.39. Preparation of a lubricant in which is incorporated a small quantity of an oil-soluble organic substituted cyanamide of formula $X=N=CN$, in which X is an organic divalent radical combination.

G. H. Davis. U.S.P. 2,216,230, 1.10.40. Appl. 30.1.37. Preparation of a lubricating oil consisting of a heavy oil containing constituents which tend to vary its pour point and a small quantity of benzidene to stabilize the pour point.

R. Rosen. U.S.P. 2,216,752, 8.10.40. Appl. 3.4.37. Production of petroleum lubricating oil for use at high temperatures, containing as an oxidation inhibitor a small amount of an oil-soluble compound with an aromatic nucleus.

B. H. Lincoln and W. L. Steiner. U.S.P. 2,127,173, 8.10.40. Appl. 19.2.36. Preparation of stabilized, high film-strength lubricating oil consisting of a major proportion of hydrocarbon oil, 0·5–10% by weight of an aliphatic ester having chlorine in chemical combination therewith and from 0·001 to 1% weight of pinene.

H. B. M.

Asphalt and Bitumen.

1599. Physical and Chemical Properties of Petroleum Asphalts of 50/60 and 85/100 Penetration. R. H. Lewis and J. J. Welborn. *Proc. Assoc. Asph. Paving Tech.*, 1940, **2**, 86–157.—It is stated that standard specifications which were considered to control the quality of asphaltic bitumen have been questioned since the introduction of bitumens from new crude sources and new refining processes. In order to determine how present bitumens conform to specifications, the Public Roads Administration requested producers to submit samples to the Federal specifications, and these were examined according to the Federal, A.S.T.M., Assoc. of American State Highway Off. specifications and by other methods used for control of quality. The investigation was confined to asphalt cements of 50/60, and 85/100 penetration, forty samples of each grade being examined; the results are tabulated and crude source and method of refining indicated.

Seven samples of 50/60 grade and six of 85/100 failed to meet one or more of the Federal requirements, one of each grade did not meet all requirements of A.A.S.H.O., and one sample of 50/60 grade did not meet the tentative A.S.T.M. specifications. The above specifications have been modified in some respect by most States, and twenty-eight of the 50/60 cements would be rejected by the various States. In the discussion of the test requirements and results obtained, the following comments are made: Four samples of each grade were lower than the Federal minimum limit for specific gravity. The minimum flash-point limit is 100° F. below the lowest figure recorded and more than 200° F. lower than the average. The average penetration was in the middle of the specified range. The softening-point limits are 104–140° F. for both grades, and the 50/60 bitumens ranged from 118° to 137° F. and the 85/100 bitumens from 111° to 123° F., the average in both cases being in the middle of the extremes. Although the minimum ductility specified by Federal is 40 cm. and by A.S.T.M. and A.A.S.H.O. 30 cm., only eight samples of 50/60 and none of the 85/100 bitumen were below 100 cm.; one sample of 50/60 was below 30 cm. ductility, whilst one sample was a little higher than 40 cm. Many samples were above 250 cm. ductility and average values were 176 and 180 for the 50/60 and 85/100 bitumens. The average loss on heating was 0·07% for the 50/60 and 0·09% for 85/100 bitumens. The penetration of the residue from the loss on heating test is required to be at least 60% of the original, and the values ranged from 70 to 94% for the 50/60 grade and from 65 to 88% for 85/100. One sample of both grades failed to meet the Federal and A.A.S.H.O. requirement of 99·5% solubility in carbon disulphide, whilst two samples of both grades failed to pass the Federal requirement of 0·2% maximum organic insoluble. All samples passed the limit of 90% minimum solubility in carbon tetrachloride.

It is stated that the data do not afford definite information regarding the source or

method of refining the bitumen, whilst uniformity of supply cannot be controlled and no indication is given as to measures necessary to prevent deterioration during mixing, construction, and in service.

In a discussion of various methods of expressing susceptibility it is pointed out that the use of the factor obtained from penetration tests at 115° F., 77° F., and 32° F. is limited owing to the fact that many materials are too soft at 115° F. One State requires that the penetration at 39·2° F., 200 gm. 60 sec. must be greater than 30% of the penetration at 77° F. 100 gm. 5 sec., and this would mean the rejection of four out of five Californian bitumens of both grades and four out of five Oklahoma and one Texas bitumen of 85/100 grade. Penetration determinations with load of 100 gm. for 5 sec. at 9° F. temperature intervals from 32° to 104° F. gave linear relationship between temperature and log. of penetration. Extrapolation showed that the penetration at the softening-point temperature ranged from 540 to 1060 for the 50/60 grade and from 620 to 1300 for the 85/100, and thus did not confirm the assumption of Pfeiffer and van Doormal that the penetration at the softening-point is 800 for all bitumens. The extrapolated values were checked on several samples by determining the penetration at 115° F. using a 6-in. needle.

It is thought that the slope of the log penetration-temperature curve is a true index of susceptibility, whereas the penetration index distorts the results. The fluidity factor is thought to be unsatisfactory for identifying the crude source, for which it was originally proposed, and while viscosity at high temperatures is of value in connection with mixing operations, a susceptibility factor based on viscosity at these temperatures may not adequately indicate change of consistency at service temperatures. The fluidity factor of 140 minimum in certain specifications would exclude a large number of the bitumens. The minimum float-test index of 90 specified for bitumens of 40/70 penetration was not met by twenty-four samples.

The various susceptibility factors when plotted against the slope of the log-penetration-temperature curve are said to show that the empirical factors are only approximate measures of susceptibility which might be used to control uniformity of supply and for identification of source of bitumens.

The ductility test under normal conditions is said to give little information on the ductility characteristics of bitumens and a comprehensive study was made of effect of temperature and rate of pull. A special machine in which temperature could be controlled, rate of pull varied over a wide range and ductilities up to 250 cm. measured. At a given rate of extension all bitumens were found to have a maximum ductility, and in most cases the ductility decreased rapidly above 95° F. Bitumens having identical ductilities with a given penetration differed widely at a different penetration. The source and method of manufacture were found to influence greatly the ductility characteristics.

A set of Mexican bitumens of varying penetration was tested for penetration and ductility at various temperatures, and it was found that the log-penetration-temperature slope was the same for each bitumen, whilst ductilities were essentially the same at the same penetration. In the low-temperature tests no relation between ductility and temperature or rate of pull common to all bitumens or to bitumens from a particular source was exhibited.

Fourteen samples of 50/60 gave positive spots in the Oliensis test, and, of these, three had xylene equivalents less than 16 and three more than 60, whilst fifteen samples of 85/100 were positive, with nine having xylene equivalents less than 16 and two more than 60. The bitumens having high xylene equivalents also failed to pass Benson's film weathering test.

It is stated that the Californian bitumens failed to pass the greatest number of requirements, and the Mexican, with one exception, the least. Bitumens of high xylene equivalents fail to pass larger number of requirements than homogeneous or slightly heterogeneous bitumens. Next to Mexican, the Venezuelan bitumen having negative spots and Arkansas bitumens show least number of failures. The authors conclude that the failure to pass many of the special requirements of bitumens from sources considered satisfactory justifies the discouragement of use of discriminatory tests that do not measure quality.

No definite correlation between test data and performance of the bitumens in service was found to indicate that any of the tests are true measures of quality or durability.

A. O.

1600. Measurement of Resistance of Oil Asphalts to Changes in Penetration and Ductility at Plant-Mining Temperatures. C. L. Shattuck. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 186–203.—It is pointed out that work of various investigators shows that petroleum bitumens gradually decrease in penetration when exposed to oxidizing conditions during manufacture of hot-mix paving materials, and while the softening-point increases in fairly constant ratio with decrease in penetration, the ductility loss varies considerably with different bitumens.

The author is of the opinion that resistance to change in ductility when bitumen is exposed to oxidizing conditions is of greater importance than retention of penetration.

An attempt was made to correlate cracking of pavements with change in the asphalt cement due to mixing operations, and tests were made on bitumens recovered, by the Abson method, from samples of sheet asphalt taken from satisfactory and badly cracked sections of streets which had been in service under similar traffic conditions for the same period.

The results indicated that the low-ductility danger point appeared to be 50 cm. at 77° F. and 10 cm. at 60° F. for pavements reported as in very good condition and 25 cm. at 77° F. and 5 cm. at 60° F. for pavements in good condition, whilst pavements were very badly cracked when ductility was less than 25 cm. at 77° F.

The penetration drop is said to be less than would be expected if cracking was due to low penetration, although pavements were in a badly cracked condition when the penetration was lower than 20.

Tests on streets constructed in 1935 with plant having latent control features were very satisfactory; the ductility of recovered bitumen was + 110 at 77° F. and 60° F. in two samples, whilst in two other samples the ductility at 60° F. had decreased from + 110 to 10 cm. It is considered that the ductility at 60° F. is of more value in comparing bitumens than the test at 77° F.

Details are given of a test to determine the effect on penetration and ductility when bitumen is submitted to mining operations; this consists in mixing 1880 gm. of Ottawa sand at 400° F. with 120 gm. bitumen at 300° F. in a small pug-mixer heated to 275–300° F., for 1 min. The mixture is then placed in a metal pan, having dimensions 7″ × 11″ × 1¼″, and heated in an oven at 350° F. for 30 min., after which it is spread on hard paper to cool and the bitumen finally recovered by the Abson method.

Tests made on a number of bitumens with Ottawa sand and with standard sheet asphalt aggregate showed that results in two laboratories were in good agreement and that hardening was greater with the Ottawa sand.

In order to confirm that the mixing test with Ottawa sand was more severe than plant-mixing, tests were made on a number of paving mixtures taken after laying. The temperature of mix, length of haul, and time from mixer to laying are recorded with tests on the recored bitumen. A. O.

1601. Analytic Mechanical Testing of Bituminous Mixes. V. A. Endersley. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 158–185.—The author states that asphaltic engineering has slowly changed from use of expensive full-scale experiments to empirical tests intended to evaluate behaviour of bituminous mixtures, and it is thought probable that mechanical tests will be placed on a true analytic basis in the near future.

It is considered that as all failures of bituminous pavements result in loss of load-carrying ability there is no basis for scientific predetermination of quality until mechanical tests become accurately related to traffic load capacity.

The method of analysis should be able to examine the factors contributing to failure or success separately, and steps in the solution of the problem are as follows: use of a method of mechanical testing which will show the different interval resisting factors separately. Evaluation of the physical and physico-chemical factors which affect the internal resistances by use of different combinations. Correlation of the factors with traffic, exposure, subgrade conditions, thickness of pavement, etc. The method which the author believes to fulfil the first requirement, and which has enabled progress to be made on the other two steps, is discussed.

In the stability test employed, known as the triaxial test, a cylinder of material surrounded by a liquid under pressure is compressed, and the relationship between the vertical loading and the lateral hydraulic pressure gives the resistance of the material. Pressures are determined at two or more levels, and the results are analysed

by means of the Mohr Circle diagram. The fundamental principles of the latter are discussed. A. O.

1602. Physico-Chemical Factors of Importance in Bituminous Soil Stabilization. H. F. Winterborn and G. W. Eckert. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 204–253.—The paper describes investigations which were undertaken for the purpose of demonstrating and analysing physico-chemical factors of importance in the bituminous stabilization of cohesive soils.

The work included the study of six soils, showing a wide variation in physical and chemical character, and eighteen bituminous materials of different origin, method of processing, and physical and chemical characteristics. An investigation was also made of the behaviour towards water of soil–bitumen systems consisting of all possible variations of the soils, including ionic modifications, and bituminous materials.

The bituminous materials were identified by means of the standard physical tests, Marcusson analysis, qualitative solubility tests, heterogeneity in various solvents. Benson heterogeneity and quantitative extraction tests. Certain modifications were made in the Marcusson procedure, and in addition to the usual Marcusson classifications the materials were grouped according to the volume of benzene required to give clear solutions in alcohol, the colour of the asphaltenes and resins and dispersability of asphaltenes in aniline.

It is pointed out that although a single qualitative test is of no value, the data obtained from examination with a series of solvents under specified conditions is useful in indicating functional relationships between materials.

In making the solubility tests ¾ gm. of bitumen was placed in a test-tube with 10 ml. solvent and examined after shaking at intervals for 3 days. Alcohols had little action on the materials, while nitrobenzene and carbon tetrachloride failed to differentiate between them. The materials were separated into two distinct groups and a third group in which members were related to each other and to members of the other groups.

Tests for heterogeneity were made by vigorously shaking the tubes and, after allowing them to stand for 1–2 hrs., pouring a drop of the supernatant liquor on to a filter paper.

Note was made whether the spot was homogeneous and of the colour intensity. Simple and differential functions were established, but did not give additional information to the solubility tests.

Successive extraction of the materials was made in a Soxhlet type of apparatus using various acetates and benzene and carbon tetrachloride.

The results are said to show that groups termed oils, resins and asphaltenes in the Marcusson separation do not possess a definite meaning, and different groups of materials having different properties may be wrongly classified.

The stabilized soil specimens were prepared by grinding the soil to pass the 40-mesh sieve, adding water to bring it to the plastic limit and 7·5% of bitumen on the air-dry soil; this was mixed until no oil clots could be detected. The mix was then manually compacted in a circular mould 1 in. high and 1¼ in. diameter, taking sufficient in one portion to prepare the specimen. After removal from the mould the specimen was slowly dried at room temperature to constant weight.

The specimens were next immersed in distilled water and weighed after periods of 1 to 36 days, after which the penetration was determined with the bitumen penetrometer using 100 gm. for 10 secs. The results obtained are tabulated and the effect of the various properties of the materials is discussed.

It is concluded that the success of bituminous soil stabilization is a function of the general character of the soil and its exchange cations, and of the character of the bituminous material employed. A. O.

1603. Avoiding Trouble in Design and Control of Oil-Aggregate Mixtures. F. R. Olmstead. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 258–289.—The author discusses the procedure adopted by the Michigan State Highway Department in oil-aggregate construction, using slow curing asphaltic oils, on approximately 750 miles of secondary roads. A. O.

1604. Graphical Presentation of Constituent Material Percentages and Resulting Stabilities of Sheet Asphalt Mixtures. R. W. Gamble and T. T. Rodgers. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 290–301.—The authors desired to obtain a picture of the data obtained from determination of Hubbord–Field stability of a large number of sheet asphalt mixtures, and the method eventually adopted was to represent the percentage composition of the mixtures by means of a triaxial diagram drawn on a piece of plyboard and stability by means of pieces of wire cut to scale and inserted in the board perpendicular to the plane. A shadow-graph was then obtained by photographing the shadows cast by the wires on a ground-glass screen A. O.

1605. Development of a Maximum Density Curve and its Application to the Grading of Aggregates for Bituminous Mixtures. W. H. Campen. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 302–314.—The paper describes the construction of a maximum density curve for bituminous aggregates up to 2½ screen size. A. O.

1606. Gradation of Mineral Aggregates for Dense Graded Bituminous Mixtures. F. N. Hueem. *Proc. Assoc. Asph. Paving Techn.*, 1940, **2**, 315–339.—In investigating the influence of aggregate gradation on behaviour of oil-mix surfacings it appeared that satisfactory surfaces could be constructed with little regard to gradation, providing the bitumen content was adjusted for the particular aggregate and gradation. The author therefore compared gradings of various mixtures which have been proposed, in an attempt to find some common feature. The data were plotted on semi-logarithmic charts, when it was found that all of the gradings passed close to the point corresponding to 31% of the material passing a size equal to 0·031 of the maximum size of the gradation, and this information was made the basis for the construction of charts for the design of mixtures. A. O.

1607.* Analysis of Bituminous Materials. R. Preston. *J. Soc. Chem. Ind.*, 1940, **59**, 99–108.—This paper is concerned with the analysis of mixed road materials, with special reference to binder contents. Since variation in the binder content is considered of greater importance than any of the other factors in the "life" of a road, it is necessary to determine accurately how closely it follows specification. The solvents generally used are discussed, and it is pointed out that trichlorethylene can only be used if the properties of the recovered binder are not required. Errors in sampling mainly arise when the bulk sample is taken, and may be due to variations in temperature, stoppages in the plant, variations in the stock pile of aggregate, time of mixing and change of composition of the mix. In the case of samples taken at the roadside, especially if open-textured and with a soft binder, the errors may be considerable. The use of a U-shaped sampling scoop is recommended and the best procedure described.

Variation in analysis results may be due to the preparation of the sample for analysis, the characteristics of the binder and aggregate, the possibility of absorption and adsorption of binder, the effect of water, and to the charges occurring in aggregate and binder during mixing or in the operations of analysis. Since analyses of synthetic mines are in general lower than expected, experiments were carried out which showed that, as the particle size of the material decreased, the difference between observed and true values for the bitumen content increased, but not proportionally. It was found that pyridine would remove further bitumen from the stone after "complete" extraction with carbon disulphide, and it was demonstrated by further experiments that some of the bitumen was adsorbed on the aggregate. This adsorption effect was not so pronounced with damp aggregate. It was further shown that the proportion of bitumen adsorbed decreased as the concentration of bitumen increased, in conformation with the Freundlich isotherm down to 0·2% bitumen for the materials used. It was also concluded that selective adsorption of the bitumen (*e.g.*, asphaltenes) does not occur. It was found that the use of a suitable mixture of solvents (*e.g.*, 1 of ethyl alcohol to 5 of carbon disulphide by volume) removed more than half of the adsorbed bitumen, and further work will be carried out on this mixture.

Sampling errors occurring in the laboratory during division of the bulk sample were found to be very small, and triplicate 500 gm. samples are recommended. Errors may arise owing to omission of the correction for water in the sample, since complete

removal of the moisture by direct drying is impossible in most cases. The method of hot extraction with toluol is preferred for rapidity and ease of control in analysis and a suitable apparatus designed to recover the solvent is described. Tables of a large number of results obtained with various types of common road surfacings show that the methods of analysis give results within the standard tolerance permitted. The errors inherent in the process of manufacture and in sampling are greater than those of the analysis. Where, however, an accuracy greater than the Standard is required, it is suggested that a correction (c) be added to the result obtained, by application of the empirical formula $C = (0{\cdot}03A + 0{\cdot}1S + 0{\cdot}2F)/100$, where A = % by wt. of stone, S that of sand and F that of filler. H. G. W.

1608.* Control of Bituminous Road Materials by Analysis. G. H. Fuidge and R. Preston. *J. Soc. Chem. Ind.*, 1940, **59**, 108–114.—While the road-binders are manufactured under close control, only a small proportion of the mixtures of these binders with aggregates is subject to similar control, and these are mainly asphalt mixtures. It was soon found that carefully graded thin carpets could give satisfactory service without surface dressing, but it is pointed out that this only arises in general if the mixes are scientifically controlled. Characteristic type of failure occur if the mixture is too fat or too lean. The permissible binder range is called the " binder latitude," and this becomes smaller the finer the aggregate grading. For a normal thin carpeting to give three years' service the latitude should not exceed $\pm$ 5%—*i.e.*, 0·5 gall./ton on a binder content of 10 galls./ton. Examples are given showing the wide variations sometimes obtained because of the general insensitiveness of the measuring devices, the development of definite inaccuracies, or inefficient operation. Results show that there is a strong case for the general application of scientific control to all bituminous mixtures used on the road, for the increased cost would be more than justified by the improved " life." No simple mechanical tests are yet available that can be generally applied in a few minutes, and thus permit hour-to-hour control. Analysis is therefore left, and using the hot extraction method (Road Research Board Report, 1936, 52) the complete result can be obtained in 24 hrs., even with tar if suitable corrections are made. Under most conditions daily samples are probably advisable, but if a plant is working efficiently less frequent sampling may be adequate. It is best to take as a sample a number of small increments from several batches on the plant. The authors quote further examples to show the value of analysis in detecting serious and unsuspected departures from the specification, the probable cause, and thus the necessary corrective measures. It is shown from these examples that when careful control is exercised, the specified mixture can be readily obtained. Periodical test, with overhaul and renovation to maintain the efficiency of the mixing plant as soon as required, are therefore advised as sound economy. H. G. W.

1609.* Stability of Emulsions. Part II. Emulsions Stabilized by Hydrophilic Colloids. A. King and L. N. Mukherjee. *J. Soc. Chem. Ind.*, 1940, **59**, 185–191.—The size-frequency technique described in the previous paper (*J. Soc. Chem. Ind.*, 1939, **58**, 243) has been applied to that important industrial group of emulsions stabilized by hydrophilic colloids. Previous work on this type of emulsions is discussed and the lack of quantitative comparison of their emulsion stabilities is indicated. Using kerosene and olive oil it has been found that most of these colloids form emulsions considerably coarser than the soap-stabilized systems, but often more stable. The smallest particles are much more stable than the larger ones at higher temperatures due to the decrease in viscosity of the continuous phase. As with soap emulsions, the analyses of the freshly prepared emulsions give little or no indication of the stability, and in this case, as well, the time of half-break may be quite misleading—*e.g.*, with lecithin-stabilized emulsions. The stability was therefore measured during both the initial rapid change and the secondary slow change, and no single numerical value could be obtained to express it (as with soap emulsions). It is pointed out that high stability alone will not characterize a good emulsion. Contrary to soap-stabilized emulsions, hydrophilic colloid emulsions vary with the nature of the oil, probably due to the greater mobility of some (*e.g.*, kerosene, which gives finer emulsions initially). These emulsions are less fine, but superior in many ways to soap emulsions, since, only with lecithin is there any separation of free oil on ageing, probably since it

gives much less viscous emulsions than with gelatin, agar agar, and the gums tragacanth and acacia, which were especially good. On the addition of calcium chloride it was found that emulsions of high viscosity (*e.g.*, gum tragacanth) were scarcely affected by the presence of calcium ions, whilst the more mobile systems (*e.g.*, lecithin and saponin) coarsened rapidly. Similar results were obtained with hydrochloric acid. In general, those agents which form very viscous emulsions or gels at ordinary temperatures give coarse stable emulsions, but if the conditions cause a decrease in viscosity (*e.g.*, heat) or a gel–sol transformation the emulsion deteriorates immediately (*e.g.*, agar agar at 85° C.). They conclude that the efficiency of these emulsifying agents is due to their power of forming a solvated membrane of considerable strength at the oil–water interface, whilst a considerable amount remains in the dispersion medium.
H. G. W.

1610. Patent on Asphalt and Bitumen. V. L. Shipp, A. H. Boenau, and J. W. Ramsay. U.S.P. 2,215,074, 17.9.40. Appl. 21.3.40. Production of an asphaltic material of relatively low temperature susceptibility and high ductility by selecting a bituminous material comprising a substantial amount of asphaltic matter and oil of relatively low viscosity index.
H. B. M.

Special Products.

1611. Patents on Special Products. National Oil Products Co. E.P. 526,699, 24.9.40. Appl. 23.3.39. Production of sulphonated fatty materials which includes subjecting a washed and neutralized sulphonated animal or vegetable oil, fat, or fatty acid to dehydration under reduced pressure.

Wingfoot Corporation. E.P. 526,743, 25.9.40. Appl. 16.2.39. Preparation of carbon sulphoselenide by reacting hydrogen selenide with an aryl isothiocyanate or an aryl thiourea and afterwards separating the resulting carbon sulpho-selenide.

Winthrop Chemical Co. E.P. 526,747, 25.9.40. Appl. 2.3.39. Manufacture of a new water-soluble sulphonamide compound by condensing *p*-aminobenzene-sulphonamide with maltose in the presence or absence of a trace of ammonium chloride.

B. E. D. Kilburn. E.P. 526,960, 30.9.40. Appl. 24.3.39. Production of sulphonated fatty materials by dispersing a crude sulphonation mass consisting of sulphonated animal, vegetable or marine oil, fat or fatty acid, in at least an equal volume of a substantially anhydrous organic solvent. Subsequently the sulphonation mass is neutralized, the inorganic salts precipitated, and the solvent and residual moisture removed by distillation.

F. Hoffmann-La Roche & Co. A.G. E.P. 527,006, 30.9.40. Appl. 18.3.39. Production of trimethyl-hydroquinone monophytyl ether by reacting a phytyl halide with trimethylhydroquinone in approximately equimolecular proportions in the presence of an alkali.

Imperial Chemical Industries, Ltd. E.P. 527,317, 7.10.40. Appl. 4.4.39. Manufacture of thiolactains by reacting hydrogen sulphide with a primary mono-aminomononitrile.

E. I. Du Pont de Nemours. E.P. 527,366, 8.10.40. Appl. 5.4.38. Preparation of a viscous hydrocarbon oil having incorporated therein a small proportion of at least one heterocyclic compound of specific formula.

T. L. Cantrell and J. S. Stockhardt. U.S.P. 2,214,875, 17.9.40. Appl. 25.6.38. Preparation of an oil-soluble organic compound suitable for use as an improvement agent for hydrocarbon oils. The compound is prepared by reacting an olefine and a phenol in the presence of a catalyst and treating at least a portion of the resultant product with a phosphorous oxychloride in the presence of a catalytic amount of phosphorus sesquisulphide.

W. H. King. U.S.P. 2,215,472, 24.9.40. Appl. 2.4.40. Production of partly oxidized products of normally liquid aliphatic hydrocarbons by introducing the

hydrocarbons in vapour phase, together with an oxidizing agent, into a reaction chamber at a temperature of 250–500° C. The materials are then reacted for 15 secs. in the presence of tetraethyl lead, the reacting materials removed, together with the reaction products, from the chamber while still in vapour phase, and the unreacted hydrocarbon and oxidation products condensed under non-reacting conditions.

W. H. King. U.S.P. 2,215,473, 24.9.40. Appl. 2.4.38. Production of partly oxidized products of normally liquid aliphatic hydrocarbons by introducing the hydrocarbons in vapour phase, together with an oxidizing agent, into a reaction chamber at 250–500° C. and reacting the materials for a period not exceeding 15 secs. in the presence of copper oleate.

W. H. King. U.S.P. 2,215,474, 24.9.40. Appl. 2.4.38. Production of partly oxidized products of normally liquid aliphatic hydrocarbons by introducing the hydrocarbons in vapour phase, together with an oxidizing agent, into a reaction chamber at 250–500° C. and reacting the materials for a period not exceeding 15 secs. in the presence of nitrobenzene. H. B. M.

Detonation and Engines.

1612.* Progress in Light Aircraft Engines. C. F. Backle. *J. Soc. aut. Engrs*, 1940, **46**, 243–249.—Progress in the production rate of light aircraft in the last few years indicates that the 1940 production will be double that of 1939 if the recent rate of increase is maintained, which would give a figure of about 6,500 aircraft in the present year. Two types of light aircraft are the most popular—viz., the 50-h.p. class and the higher performance types up to about 90 h.p. Details are given of the means adopted to increase the output of one 50-h.p. engine, which ran at 1900 r.p.m. with 65 octane fuel and 5·4–1 compression ratio, to 90 h.p. running at 2700 r.p.m. with 80 octane fuel and 7·5–1 compression ratio. This entailed modification of cylinder-head design, exhaust valves and seats, pistons and rings, valve mechanism, and fuel injection equipment. A detailed discription of the fuel injection equipment is given, and the merits of fuel injection are dealt with. C. H. S.

1613.* Engine Deposits—and the Effect of some Fuel Additives. J. A. Moller and H. L. Moir. *J. Soc. aut. Engrs*, 1940, **46**, 250–261.—This article describes apparatus used and procedure followed in extensive tests made to examine the manner in which fuel-residue deposits are built up and dispersed, and the effect of various fuel additives on such depositions. The data obtained on a number of engines of various types were found to be relatively comparable, and for the sake of brevity the result from one engine and from one type of additive only are dealt with in detail. A laboratory apparatus for determining gum-solvency effect of additive compounds is described which consists of a carburettor connected to an electrically heated chamber in which is placed a plate with a known weight of gum. Fuel is drawn through this chamber and condensed, the collecting flank being connected to a vacuum line. The "gum solvency" properties of the fuel are determined by loss of weight of the coated plate.

To facilitate the examination of engine deposits at frequent intervals during a test, special pistons with removable heads were used.

Many photographs are reproduced which show how the engine deposits build up in wave-like formations and become dispersed, the dispersal presumably being due to mechanical blowing away of loosened particles, or to burning of the deposit because it had lost its ability to dissipate heat after severing its bond with the metal. The effect of varying load and speed is dealt with at some length.

Road tests were made to determine the effect of deposits on octane-number requirement of various cars over extensive mileages with and without additives in the fuel.

It is shown how carbon deposits reach equilibrium conditions and how the use of the proper quantity and type of additive makes it possible to obtain and maintain minimum deposition, with consequent improvement in engine condition. C. H. S.

1614.* Status of Fuel Performance Tests in Aviation Engines. R. F. Gagg. *J. Soc. aut. Engrs*, 1940, **46**, 271–272.—The author contends that single-cylinder engines using full-size cylinders often give misleading results in rating aviation fuels because of

unavoidable dissimilarity in the single-cylinder and multi-cylinder operation, and thinks that such test units should be employed only as a pilot for full-scale testing until the results of the two kinds of tests are in substantial agreement and are validated by actual service experience. The procedure for detonation rating tests of fuels in aircraft engines already developed by the Co-operative Fuel Research groups has proved quite satisfactory for measuring fuel characteristics at cruising powers, but it seems clear that no fuel test or comparison at a single power-output level can provide all the information needed to judge its qualities for take-off operation. To make a series of test runs similar to the cruising rating test, but at increasing power output values, is slow and cumbersome, although it would supply the necessary data. A procedure is outlined and actual test data are given showing results obtained by running only the "end-points" of the mixture control runs previously mentioned. In these tests the throttle is gradually opened with other engine conditions held constant until the fuel begins to exhibit signs of distress. The procedure is repeated at various mixture strengths, and curves are thus established showing maximum permissible power outputs at varying mixture strengths. This type of test does differentiate between fuels for use at take-off power conditions, a result which cannot be accomplished by the single test used for cruising rating. C. H. S.

1615. Criterion for Knock in Petrol Engines. R. C. Plumb and A. C. G. Egerton. *J. Instn. Mech. Engrs*, Sept. 1940; *Proc.*, 1940, **143** (4), 247–260.—The customary methods of rating fuels for their knocking characteristics—*i.e.*, by determining their highest useful compression ratio or by comparing them with standard reference fuels—are depending on standardized engine conditions; the results are not always valid for widely different engine conditions. The authors' problem was to correlate the knocking tendency of a fuel with the physical conditions in the cylinder which cause the knock, and with its ignition qualities in a bomb. The method of approach was to find a function of the physical conditions, such that the attainment of a critical value during the stroke by this function would be a criterion of knock. This critical value should depend solely on the fuel–air mixture used, and be entirely independent of engine conditions. Consideration of the physical conditions affecting the tendency of the end-gas to knock at any instant t leads to the conclusion that the criterion should be of the form: (amount of peroxides present) × (some function of the physical conditions at the instant t).

Engine tests were made on two blends of technical *iso*-octane and *n*-hexane, and on a commercial gasoline. The octane numbers were 57, 81, and 75, respectively. The engine used was a single-cylinder unit; the compression ratio was varied in steps between 4·9 and 8·23 : 1. Knocking conditions were detected by means of a cathode-ray oscillograph. The method of test was to determine a series of operating conditions—compression ratio, air–fuel ratio, etc.—which would cause incipient knock; for each set of conditions indicator diagrams were recorded photographically.

The form finally selected for the criterion was

$$F = \rho P \int_0^t r(P - P_e)dt,$$

where ρ denotes mean gas density in the cylinder at time t from the start of reaction, P the absolute pressure at time t, r the surface/volume ratio at time t, and P_e the absolute pressure at which reaction, leading to the formation of peroxides or other intermediate products, starts. The method of evaluating F is explained; it is shown that, for each fuel under conditions of incipient knock, the maximum value of F approaches a constant independent of the running conditions. In another engine the numerical values would be different, but the form probably very similar. The accuracy of the calculation and of the form of the criterion are discussed. It is suggested that this work may be a step towards the establishment of a more rational method of knock rating.

Ignition experiments in a bowl indicated that the same critical value of the same function is a criterion of auto-ignition, and they suggested a similarity between the mechanism of knock in an engine and auto-ignition in a bomb. K. A.

1616.* Oil Filtration. A. H. Stuart. *Auto. Engr*, 1940, **30** (399), 213.—The theoretical considerations of a filter are first dealt with, the effect of viscosity, etc., pressure, and

fineness of mesh being noted. Filtering efficiency without qualification is stated to be meaningless, as in general a compromise has to be struck between rate of filtering and the degree of removal of unwanted material. Even although a used I.C. engine oil has been filtered and "looks like new," much unwanted and harmful material is left behind. A description is given of possible contaminants, particularly those which are not in general removed by filters—namely, those caused by high-temperature reactions at the cylinders walls or on the pistons.

Considering the types of filters in use, it is shown that an increase in pressure will not always cause an increase in the rate of filtration, and may even cause a considerable reduction. Gauge, edge, and cloth type filters are discussed, as well as those using paper. The surface action of filter papers is dealt with, and an experiment is described showing how important is the p_H of the filter in relation to the filtering power of the unit—*i.e.*, whether it causes flocculation or not. This surface action is particularly noticeable in filters incorporating Fuller's earth or activated charcoal. Although the oil from these units may appear extremely clean, it is pointed out that actually this may be undesirable, as active constituents, especially added to the oil, may have been removed. It may be argued that once this surface activity is satisfied, no more adsorption can take place; experiments with oilclay have shown, however, that even after repeated circulation through the filter the surface action continues to remove decreasing amounts of the graphite at each circulation. The rate of filtration in this experiment actually increased with increasing time in circulation.

Lubrication experts are endeavouring to increase the usefulness of lubricants by incorporating small amounts of active ingredients; on the other hand, certain filters are being designed to "refine" the oil in the crankcase. Unless some co-operation can be achieved between these antagonistic endeavours, further improvements in lubricating oils will be obstructed. Recent papers have dealt with this subject, and stressed the danger of some types of filters removing essential additions. It would appear that the best results would be achieved by the use of a full-flow filter with the minimum of absorptive properties combined with frequent renewals of the oil. In the latter connection it has been shown that the bearings of engines operating with frequent renewals of oil were in better condition than those using less frequent changes but more efficient filtration. H. L. W.

1617.* Road Performance of Gasoline Obtained in Laboratory Tests. Anon. *Nat. Petrol. News*, 29.5.40, **32** (40), R.202. *Abstracts of Paper by H. G. Smith at 10th Mid-Year Meeting of A.P.I. at Fort Worth* 30.5.40.—A full-scale engine-laboratory test method for indicating the average road performance or road octane numbers is being expanded to larger use after 3 years of experimental work which has indicated the reliability of the method. The method is known as the A.I.L. (acceleration-inertia-load) test. Studies already carried out indicate that a reduction of the cooling-water exit temperature is accompanied by a decrease in the octane-number requirement, whilst a substitution of water for dilute alcohol as the cooling medium has the reverse effect, owing to the decreased heat capacity of alcohol. Empirical formulæ for converting octane numbers (A.S.T.M./C.F.R.) into A.I.L. ratings are given. The conversions involve the acid-heat value (A.S.T.M.). H. G.

Economics and Statistics.

1618. Petroleum Statistics, 1935–38. G. R. Hopkins. U.S. Bureau of Mines, Economic Paper 20.—G. R. Hopkins, Assistant Chief Economist of the Petroleum Economics Division, U.S. Bureau of Mines, provides a useful history of petroleum statistics of the United States. There are also particulars of the form in which they are now presented, and of the sources from which they are derived. Prior to 1925 statistics were collected by the Geological Survey. On 1st July, 1925, the work was transferred to the Bureau of Mines. The historical development can be summarized as follows :—

1882.—Annual figures of crude-oil production by States and fields published by Geological Survey. Subsequently fewer and fewer figures by fields became available, owing to difficulties of obtaining details of pipe-line runs; data are now limited to a few of principal fields.

1883.—Pipe-line stocks, back to 1871, first published.

1917.—Bureau of Mines commenced statistics of refined products (production and stocks). This was primarily a military measure.

1921.—Data on producing wells published by Geological Survey. Subsequent information is obtained from *Oil & Gas Journal*, *Standard Oil Bulletin* and American Petroleum Institute.

1925.—Bureau of Mines took over Geological Survey statistical work. Tables of supply and demand for all oils first published. Statistics of imports and exports obtained from Bureau of Foreign and Domestic Commerce.

1926.—Annual figures of fuel-oil distribution started.

1927.—Figures first published of production of gasoline by cracking.

1933.—First issue of *Minerals Yearbook*, in which all petroleum statistics were assembled.

1934.—First figures obtained of crude-oil stocks by States of location, subsequently incorporated in weekly figures.

1939.—Bureau of Foreign and Domestic Commerce established new classifications for import and export data, which agree more closely than previously with Bureau of Mines classification.

Each of the series of statistics referred to above is illustrated in the paper by monthly and annual figures relating to the years 1935–1938. S. J. A.

1619.* Crude Petroleum and Petroleum Products. A. G. White, G. R. Hopkins, and H. A. Breakey. U.S. Bur. of Mines. Chapter (preprint) from *Minerals Yearbook*, 1940, Review of 1939, with Final Statistics for 1938. 100 pp. 15 cts.—The chapter on crude petroleum and petroleum products to be included in the *Minerals Yearbook* for 1940 has already appeared as a separate publication. Apart from detailed statistics on reserves, supply, demand, production, consumption, and prices of crude petroleum and refined products, it contains some interesting data in summary form.

In 1939 world production of crude petroleum amounted to 2077 million barrels, and represented an increase of 38 million barrels over the previous peak figure attained in 1937. The United States was responsible for 61% of the world total, as in previous years, but there were increases of 18 million barrels in Venezuela, 4 million barrels in Netherlands Indies and 8 million barrels in Soviet Russia. Production in Rumania again declined, and was 15 million barrels less than in 1935.

Incidence of the war in September 1939 had less effect on the oil industry in the United States than had been anticipated, although the last quarter of that year was characterized by a very active fuel-oil market. The fact remains, however, that large foreign war demands did not materialize, and, in consequence, there was at that time a large excess production of gasoline.

Changes in regard to world oil consumption due to war conditions were somewhat clarified during the first quarter of 1940, it then becoming apparent that much of the increase in war demands could be offset by restrictions of civilian consumption. As far as the United States were concerned, certain important markets were cut off by blockade; exports to many neutral countries were reduced and legislative restrictions affecting movement of American ships into war zones diverted the demand for oil to other sources. Thus total exports were approximately 23% less in the first quarter of 1940 than in the same quarter of 1939.

The total demand for oils in 1939 of 1418 million barrels established a new record, and was about 75 million barrels higher than the previous peak figure attained in 1937. Domestic demand largely accounted for the increase, it being 92 million barrels greater in 1939 than in 1938. H. B. M.

1620. Natural Gas. F. S. Lott and G. R. Hopkins. Chapter (preprint) for *Minerals Yearbook*, 1940. U.S. Bur. of Mines.—The estimated consumption of natural gas in the United States during 1939 was $2{\cdot}435 \times 10^{12}$ cu. ft. This was 6% more than in 1938. Conspicuous increases occurred in Pennsylvania, Ohio, and West Virginia, in consequence of expansions in the steel and related industries, induced by the European war. The average value at points of consumption was 22 cents per thousand cubic feet.

A brief review is given of legislation, employment, completed and producing gas-wells, and a more detailed account of exploitation in different fields and of pipe-line developments. Following an analysis of principal consumers, it is stated: "Among recent

applications of natural gas to industrial processes may be mentioned the production of inert atmospheres from products of gas combustion. These inert gases are useful in the manufacture and storage of a number of materials, notably paints and varnish, to prevent or reduce oxidation. The greatest potentialities for the future, however, are indicated by new chemical techniques and discoveries that will utilize natural gas as a raw material. The manufacture of such bulk products as fabrics, a variety of plastics and synthetic rubber is emerging on a commercial scale."

Reference is made to U.S.B.M. Circular 7108, H. M. Smith on Utilization of Natural Gas for Chemical Products. (See Abstract 923, Oct. 1940.) S. J. A.

1621. Natural Gasoline and Liquefied Petroleum Gases. G. R. Hopkins. Chapter (Preprint) from *Mineral Yearbook*, 1940. U.S. Bureau of Mines.—The production of natural gasoline in U.S.A. during 1939 was about 3% less than in 1938. This was largely accounted for by diminution of exports. No spectacular advances in established production methods are reported, but use of the re-cycling process continues to expand rapidly. Much progress was also made in producing high-octane gasoline from the lighter hydrocarbons.

The demand for liquefied petroleum gases continued to increase. Approximately equal proportions of propane, butane, and propane–butane mixtures are sold. Domestic uses account for about 40% of consumption. Pentane is principally used in chemical manufactures. An appreciable quantity (30,000,000 gal.) is used as motor fuel. S. J. A.

ERRATUM

Abstracts Nos. 1093 *and* 1257. For Slater read Sclater.

PUBLICATIONS RECEIVED.

Cylinders for Compressed Gases (Fuel for Motor Vehicles). Regulations of Home Department, issued 18 Nov. 1940. Statutory Laws and Orders, 1940, No. 2009. H.M. Stationery Office, 3*d*.

These Regulations apply to cylinders containing coal gas, carbon monoxide, hydrogen, or methane, when fitted to a motor vehicle for use as fuel. The General Specification requires that such cylinders be solid drawn or made from seamless steel tube, by an approved cylinder manufacturer. Detailed Specifications refer to two types as under :

	Specification A.	Specification B.
Mark.	GP.	GPM.
Maximum working pressure for which cylinder is designed.	3000 lb. sq. in.	1800 lb. sq. in.
Thickness of cylinder walls (" *t* ").	0·035 *D*, where *D* is ext. diam. in inches.	0·03 D,
Tensile test (on material of finished cylinder) :		
Yield stress.	Not less than 45 tons sq. in.	Not less than 26 tons sq. in.
Ultimate stress.	Not less than 55 tons sq. in.	42 to 48 tons sq. in.
Elongation.	Not less than 7%.	Not less than 15%.

Chemical composition, notched-bar tests, and bend tests are specified.

In addition, each completed cylinder shall be subjected to a hydraulic stretch test, preferably by the water-jacket method. The proof pressure for Specification A cylinders is 4500 lb. per sq. in.; for Specification B cylinders 1¾ times the designed working pressure. For Specification A cylinders one in every 200 shall be hydraulically tested to destruction (minimum bursting pressure : 7800 lb. per square inch).

At the time of filling, the gases must be free from hydrogen sulphide, and the interior of the cylinder free from oil, grease, grit, etc. Cylinder valves must be of forged steel, brass, or bronze, in accordance with the Third Schedule of these Regulations. Provision is also included for marking and painting, fusible plugs, or bursting discs, and for re-testing at intervals of not less than one year.

British Standard No. 789A–1940 : Steel Tubes and Tubulars—Light-weight and Heavy-weight Qualities. (Revised Weights.) Pp. 23, British Standards Institution, 28, Victoria Street, London, S.W.1. Price 2*s*. net.

A War Emergency British Standard Specification, to meet the urgent need for the utmost economy in the consumption of steel, superseding B.S. No. 789, and prepared at the request of the Ministry of Supply.

The specification provides for the replacement of the three qualities of tube provided in B.S. No. 789—namely, gas, water, and steam qualities—by two qualities designated respectively " light weight " and " heavy weight." The " light-weight " quality is one gauge lighter than the " gas " quality of B.S. 789, and the " heavy-weight " is the same gauge as " water " quality of B.S. 789.

The specification incorporates changes to clauses in B.S. 789, and among the clauses affected are those concerning : percentage of lengths joined together, tolerances, hydraulic test, marking for indication of quality and longscrews.

Dimensions of sockets are unaffected.

British Standard No. 902–1940 : Methods of Testing Latex, Raw Rubber and Unvulcanized Compounded Rubber. Pp. 29, British Standards Institution, 28, Victoria Street, London, S.W. 1. Price 3*s.* 6*d.* net.

The British Standard Methods of Testing Latex, Raw Rubber, and Unvulcanized Compounded Rubber have been based on those of the London Advisory Committee for Rubber Research (Ceylon and Malaya) and those of the Research Association of British Rubber Manufacturers as published in *Rubber, Physical and Chemical Properties.*

The methods of testing latex—*i.e.*, a suspension or emulsion of rubber globules in a water liquid or serum—cover sampling, analysis, and colour measurement. A standard colour chart (containing one substantially white shade, three grey shades, and one yellow shade) is included in the specification.

The methods applicable to raw rubber—*i.e.*, the crude material obtained on coagulation of latex, and found in sheet, crepe, lump and powder forms—and to unvulcanized compounded rubber—*i.e.*, the mixtures obtained from raw rubber by the incorporation of various ingredients, cover chemical analysis and physical test.

These methods require reference to British Standards Nos. 381, 410, 612, 627, and 902.

Tests for ammonia content and stability of latex and a vulcanization test for the evaluation of raw rubber are under consideration for incorporation in a future edition of these methods.

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INSTITUTE NOTES.

DECEMBER, 1940.

MEMBERS SERVING WITH H.M. FORCES.

Corrections and additions to the first list of members serving with H.M. Forces, published in the October *Journal*, are given below. The Secretary will be pleased to receive additional information from time to time.

Adlington, R. E., promoted Major, R.A.
Rowntree, W. B., promoted Major, R.A.S.C.

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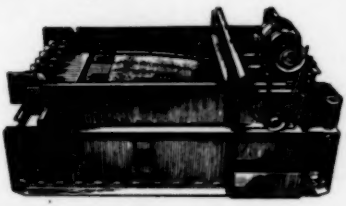

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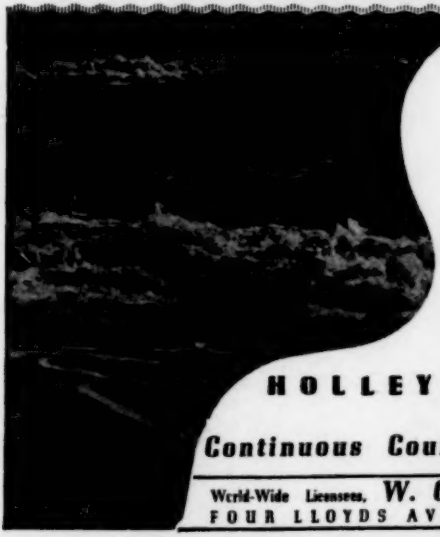

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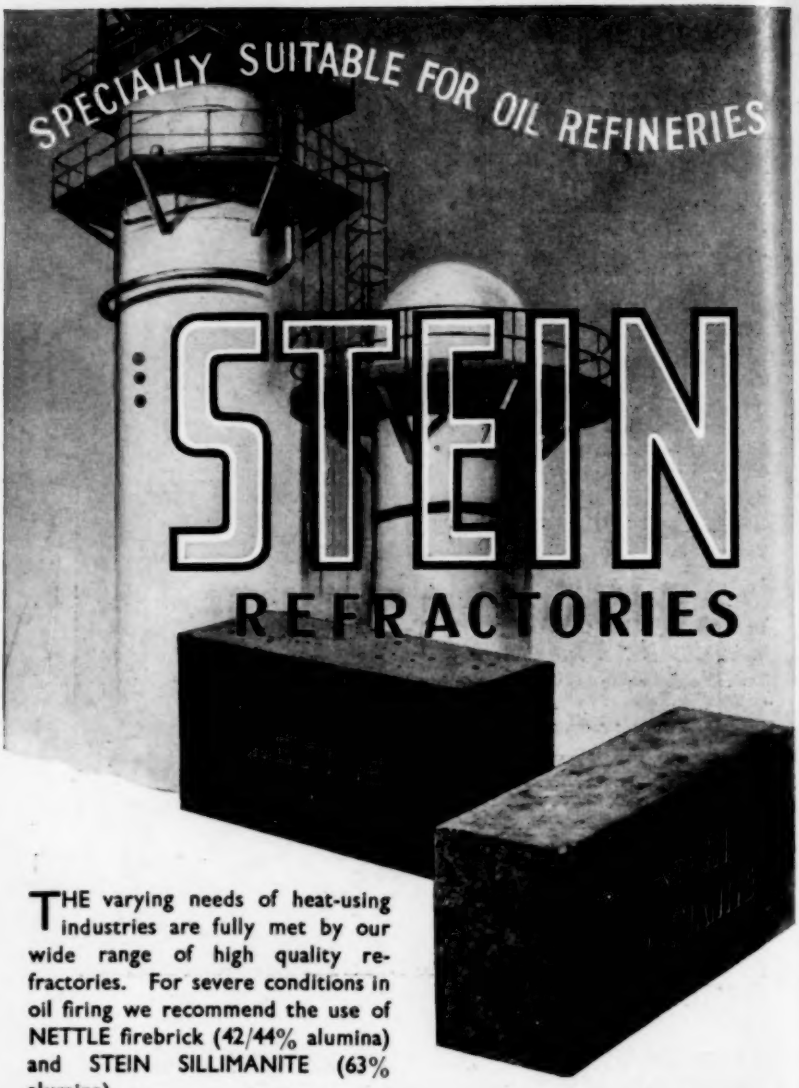

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